Vocabulary Deficits in Children with Specific Language Impairment

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Declaration of Authorship

I declare that I have written this thesis myself and that the work in it, is my own work.

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Abstract

Children with Specific Language Impairment (SLI) have unexpected difficulty developing language in the absence of a clear aetiology. Slowness to acquire their first words is a hallmark of SLI and a proportion of the children continue to have a vocabulary deficit (poor receptive and/or expressive vocabulary) compared with their peers. Some recent research suggests that children with SLI are poorer than controls at learning new words in experimental settings, but the nature and source of their word learning difficulties are still poorly understood. In particular it is unclear what aspects of new vocabulary are particularly hard to learn and which underlying cognitive processes are impaired.

This thesis presents two sequentially related investigations which aim firstly to clarify the extent and nature of word learning deficits in children with SLI, and then to explore the source of their difficulties. In both studies, 16 children with SLI, including poor receptive vocabulary, were compared to two control groups, one matched for age and non-verbal ability, and another for receptive vocabulary and non-verbal ability.

In the first investigation, four unfamiliar words were introduced six times in each of two contexts, a Story and an Explicit Teaching context. Assessments exploring whether children had learned the sound (phonological form) and the meaning of the experimental words were carried out.

Children with SLI were significantly poorer than the age matched controls on all tests of word learning. They were similar to the vocabulary matched controls on all measures except the naming task on which they were significantly poorer. The results suggest that children with SLI have global word learning problems but that they may have particular difficulty acquiring the phonological form of new words.

The second study investigated whether SLI children's word learning difficulties were due to problems in acquiring new phonological forms and/or in linking components of

lexical representations. To study phonological learning, a paired association task was used in which children had to learn to associate nonwords with familiar words. Lexical linking was explored using the same procedure but with pairs of real words. The groups were also compared on seven measures of phonological processing and the relationship between phonological learning and processing was analysed in each group.

Children with SLI were significantly poorer than age matched controls on the immediate recall (but not longer-term retention) of items from both paired association tasks and on all measures of phonological processing. They did not differ significantly from vocabulary matched controls on phonological learning, lexical linking or on five of the measures of processing. However they were significantly poorer at discriminating between words which differed in phoneme sequence and at repeating nonwords. Most of the correlations between phonological processing and phonological learning were not significant.

These results suggest that lexical linking, phonological learning, processing and memory are poor in children with vocabulary deficits. However the evidence for phonological processing deficits being a cause of vocabulary deficits is less clear-cut.

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CHAPTER 1 LITERATURE REVIEW

1. Prologue

"Sheriffs" that visit the baby Jesus, *"waterfalls that go up the way"* in front of a well known hotel, *"moonbirds"* than come out at night and a *"rhinositis"* that roams the plains of Africa...... These interesting errors are not uncommon in the experience of Speech and Language Therapists working with children who have language impairments. And for many of these children, such errors are merely the more obvious symptom of a vocabulary deficit which not only affects their ability to express themselves correctly in words but also compromises their ability to understand words at a level commensurate with their age.

Vocabulary deficits may not always be apparent in everyday conversation and for some children standardised assessments of vocabulary are required to demonstrate the extent of their difficulty with words. While working in a Language Unit, a special educational provision for children with problems acquiring language, I noticed that children's vocabulary deficits were a major concern for teachers and therapists because children's test scores for receptive and expressive vocabulary were frequently poor and difficulties learning and retaining words were often observed. Staff questioned why children performed so poorly on tests, and why they made the mistakes they did. Most importantly we wanted to know what form of teaching/ therapy would best meet their needs. The work in this thesis was motivated by the need to understand vocabulary deficits.

An important premise of the research which will be described in this thesis is that vocabulary deficits are yet another manifestation of the difficulties which children with language impairments have in *acquiring* language.

1.1 An introduction to the literature review

Although research into vocabulary deficits has been limited, particularly when compared with the other aspects of communication development in children with SLI, interest in this area has increased, particularly in the last ten years. Much of this more recent research has attempted to understand vocabulary deficits by exploring word learning in experimental conditions or by investigating the cognitive processing skills relevant to vocabulary acquisition and use. Consequently the bulk of the literature review will address these areas of enquiry in two main sections.

The first section focuses on previous research on word learning in children with SLI. It considers whether this work has demonstrated that children with vocabulary deficits have intrinsic word learning problems, rather than for example, limited opportunities for acquiring new words. This section also considers what these studies tell us about the nature and source of word learning deficits. Overall it will be seen that while our understanding of vocabulary deficits in children has increased as a result of this work, there are gaps in our knowledge which require ongoing investigation.

The literature review then considers what models of lexical processing and evidence about the relationship between phonological memory and vocabulary development can contribute to our understanding of vocabulary deficits. These areas of research have become increasingly prominent recently but it will be seen that as yet they do not offer clear indications of either the nature or source of vocabulary deficits.

Based on the current state of knowledge, the literature review identifies a need for further research into word learning and into lexical processing and phonological memory in children with vocabulary deficits. However it is suggested that these investigations should be interrelated and that the results from a study of word learning should provide data on which to base the next stage of the enquiry.

Before reviewing the literature in this way, some of the terminology which is commonly used throughout this thesis will be explained.

1.2 What is a Specific Language Impairment ?

Specific Language Impairment (SLI) is a constitutional difficulty with the acquisition of language. The difficulties children experience in learning language cannot be attributed to overall intellectual deficit, hearing loss, gross neurological dysfunction, environmental deprivation or emotional disorder. Consequently SLI is currently considered a developmental condition of unknown aetiology.

Children with SLI are not a homogeneous group. For some, difficulties may be most apparent in the ability to express themselves. Other children have difficulty understanding <u>and</u> producing language. Variations in severity occur, and the components of language affected may also differ among children. For example, some children have greatest difficulty with the grammar and pronunciation of language while others particularly struggle with its meaning and use.

<u>Prevalence of SLI</u>

Prevalence refers to the percentage of cases in a population of a particular condition at a given point in time. Figures on the prevalence of SLI in children are very variable and estimates depend on the age at which children are studied (numbers are larger when children are pre-school), and the criteria used to define SLI (e.g. the extent and number of difficulties on formal assessments). Based on 16 prevalence estimates of speech and language delays in children up to 16 years old from 21 publications, Law et al. (2000) suggested an average prevalence of primary speech and language delay of almost 6%. Thus SLI appears to be a relatively common condition.

1.3 What is a vocabulary deficit ?

The term 'vocabulary deficit' is a general one and is used in this thesis to describe two main types of problem. Children either have difficulty in understanding <u>and</u> producing vocabulary at a level appropriate to their age or they have problems with expressive vocabulary only.

Although there is considerable variation in normal vocabulary development, a deficit is usually identified on formal testing if children score significantly below average on assessments of receptive and/or expressive vocabulary. However children may also have a vocabulary deficit if, despite normal test results, they display difficulty in producing words in conversation that is obvious to the listener or affects their communication adversely.

In the literature a variety of terms are used to refer to difficulties with vocabulary. General terms which are interchangeable include 'lexical deficits' and 'vocabulary deficits/problems'. These tend to be rather broad terms which include overall problems in understanding and using vocabulary, as well as more specific conditions such as word-finding difficulty.

The terms 'word-finding difficulty' (WFD) and 'word/lexical retrieval problems' are more specific and are generally both used to indicate a problem with expressive vocabulary. These terms imply that children have stored words in their memory but can have difficulty accessing them at a given moment in time. WFD is characterised by e.g. errors in the words used, slowness to find words, hesitations, circumlocutions and overuse of non-specific words such as 'thing' and 'stuff' (Kail and Leonard, 1986; McGregor and Waxman, 1998). Despite difficulty in producing the word, children are usually able to understand it or select the word they cannot produce from a range of alternatives. This does not necessarily mean that children with WFD have age appropriate vocabulary comprehension. Indeed a number of these children also have limitations in their receptive vocabulary (Bishop, 1997; Dockrell, Messer, George, & Wilson, 1998). However, their difficulties producing words are greater than would be expected on the basis of their vocabulary comprehension.

'Naming difficulties' (Swan and Goswami, 1997; Wolf, 1992) is a term usually applied to expressive vocabulary deficits in children with dyslexia. In common with word-finding difficulties, these usually occur despite the child being able to recognise the intended word and may result in errors and slowness in naming.

Vocabulary deficits can occur in a variety of children including those failing at school, children with dyslexia and children with Specific Language Impairment (Dockrell et al., 1998). In this thesis, research into vocabulary deficits will focus on the latter group.

1.4 Prevalence of and explanations for vocabulary deficits in children with SLI

Two recent studies (Conti-Ramsden, Crutchley, & Botting, 1998; Dockrell et al., 1998) suggest that vocabulary deficits occur in a sizeable percentage of children with SLI. Conti-Ramsden et al. found that 34% of a random sample of 242 children in their second year in a language unit scored below the 12th centile on the naming subtest on the British Ability Scales. Dockrell et al. found that survey returns from speech and language therapists and teachers supporting over 7000 children with language difficulties indicated that 23% of these had WFD. In addition, an earlier study by Conti-Ramsden et al. (1992) found that in a sample of 15 children attending language units aged 6-7 years old, the average standard score on the British Picture Vocabulary Scale was significantly poorer than chronological-age-matched controls and almost two standard deviations below the test average.

As described in section 1.3, children with SLI may have overall limitations in their vocabulary development involving comprehension and expression. They may have word-finding difficulty, or they may have a combination of both.

One possible explanation for overall limitations in a child's vocabulary is that children with SLI are slower or less efficient in their acquisition of new vocabulary. This is borne out by a number of observations in current research. Leonard (1998) suggests that a characteristic of children with SLI is their slow early (and sometimes subsequent) vocabulary development. The notion that children with SLI are relatively slow to produce their first words has been confirmed by a recent retrospective study by Trauner et al. (2000). In this research, parental reports suggested that as group, children with SLI were significantly slower than controls with normal language development to produce their first words (average ages of 22.7 months and 10.3 months respectively). In a number of children, this early slowness to acquire vocabulary persists and may even become more marked with age. This was apparent when studying the profiles of pupils with SLI in a residential school (Haynes, 1992). The author found that, although on starting school, grammar and coherent language were the weakest areas, the least progress was made in vocabulary. In this area, standard scores decreased and there was an increasing gap between chronological age and level of vocabulary.

A significant drop off in scores was also noted between the ages of 8 and 15 years in a group of children who had been identified as having persistent language difficulties at 5½ years (Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). Furthermore Ajuriaguerra (1976), reported an early longitudinal study in which 17 of an original group of 40 children with language deficits were followed up on average two years later. These children, described as dysphasic, were similar to the children now known as SLI. At follow up, one third of them made little progress in vocabulary development despite intensive training.

In the case of word-finding difficulty a rather different explanation has been assumed to account for the children's vocabulary deficits. The term implies that the problem lies in the retrieval mechanism for word production. Thus the word is thought to be stored in memory but difficult or impossible to access at a given moment in time. However a considerable body of work by Kail and Leonard (1986) has cast doubt on the notion that difficulty with *retrieving* words is a satisfactory explanation for WFD in children with language impairment. Instead these authors suggest that WFD might be explained by the fact that some words have less elaborate semantic representations in memory. The fact that they have a poorer and weaker network of semantic associations with other words makes them harder to access but the underlying difficulty is not with retrieval. Rather, limitations in storage account for WFD.

This view was confirmed by the results from a series of very varied experiments in which various groups of language impaired children aged between six and thirteen years were compared with language age matched and/or chronological age matched controls.

Experiments were designed to examine storage and retrieval processes. Among the tasks used were 'repeated free recall', in which words were read to children which they were then asked to recall on three occasions separated by short time gaps, 'unconstrained free recall', in which children were asked to provide as many words as possible within a given category, 'multidimensional scaling of category members' in which children were asked to judge the similarity of pairs of items from the same category, and 'picture naming in context' in which variable amounts of prior linguistic context preceded the requirement to name a picture. From their overall analysis of the seven experiments Kail and Leonard considered that retrieval deficits did not explain WFD in children because although the SLI groups were often slower to respond than the controls there were qualitative similarities in their responses which suggested that the retrieval process in children with SLI was similar to that of their peers. For example, on the free recall task when asked to name as many animals as they could, children with SLI produced fewer items and there was less evidence of subcategories in their responses e.g. farm animals, zoo animals etc. However the SLI children were similar to normally developing children in the organisation of their responses (evident in the order in which they generated items and the pauses which occurred between items in different subcategories) suggesting that their retrieval process was similar to the controls.

Subsequently some authors (Mc Gregor, 1997; McGregor and Waxman, 1998) have also suggested that limitations in the information stored about words' meanings is implicated in WFD. In the first of these studies McGregor (1997) analysed the errors made by 12 pre-school children with WFD compared with children of the same age with normal language development to make some observations about the lexical storage system in children with WFDs. She suggested that their high rate of semantic errors might indicate that the children lacked sufficiently elaborate semantic information for accurate naming perhaps as a consequence of more protracted acquisition of semantic information. However she also raised the possibility that semantic errors might occur because there was a deficiency in the phonological form of the word. In the second study McGregor and Waxman (1998) used the qualitatively different error profiles in children with WFD compared with age matched children with normal language development as evidence for deficiencies in lexical storage in children with WFDs. The experimental task involved showing children pictures and asking them three contrast questions about each one to elicit the use of superordinate (e.g. animal), basic level (e.g. dog), and subordinate terms (e.g. dachshund). Children with WFDs produced a significantly higher proportion of indeterminate errors (don't know responses or acceptance of the suggested incorrect subordinate) and significantly fewer substitution errors for subordinates than the controls. This the authors took to indicate deficiencies in lexical storage because acceptance of the incorrect words suggested that the children had not stored enough semantic information to allow them to differentiate between words with shared meanings.

The views of Kail and Leonard (1986), McGregor (1997), and McGregor and Waxman (1998) in relation to WFD are therefore more compatible with the notion that WFDs are related to the problems that children with SLI have with learning words. Leonard (1998) explains it thus " If one imagines that SLI is a type of filter such that some but not all experiences with a word are registered in semantic memory, then it seems reasonable to suspect that the strength and number of associations in the semantic memories of children with SLI are weaker and fewer than is the case for age-mates. The resulting network of associations would be akin to that seen in younger normally developing children .....Although this would have a detrimental affect on retrieval, the problem is not one of retrieval" (p.47).

1.5 What is meant by 'word-learning' ?

The term 'word-learning' refers to the process by which children (and adults) add new words to their vocabulary. It is a skill which is evident from very early on in language development (most children use their first words from about 12 months) but it is also one which usually continues at different rates throughout life. Figures indicating the remarkable capacity to learn vocabulary in children with normal language development are often quoted. However a particularly fast rate of acquisition (around 3000 words a year) has been reported in the middle to later school years (Nagy & Herman, 1987).

Learning even one word is more of a feat than it first appears. Gathercole (1993), drew attention to the complexity of the process of learning even one new word: "The novel phonological form of the word has to be accurately segmented and perceived. It then has to be successfully learned; that is a long term memory representation of the phonological sequence has to be constructed. The meaning of the word - specified by referent, context and grammatical class - has also to be identified and analysed by the child, and stored with the long term phonological representation" (p.188).

Although it seems reasonable to assume that difficulty with some or all aspects of the word learning process must account for poor rates and levels of vocabulary development, one cannot rule out other factors such as the quality and quantity of language in the child's environment. For this reason, and also to observe the way in which the process might be breaking down, studies of word learning have been designed to mimic natural opportunities for word learning albeit with some experimental control. Gathercole (1993) endorses this approach as follows: "In order to analyse the word-learning deficit of language impaired children in more detail it is necessary to investigate the vocabulary learning skills of language-disordered children using laboratory-based word-learning techniques" (p189).

1.6 Studies of word learning in children with SLI

It is only relatively recently that research has addressed word learning in children with SLI and work in this area is limited. Two main experimental paradigms have been used. One of these investigates the initial stage of word learning viz. fast-mapping/quick incidental learning (QUIL). In the other experimental paradigm, viz. instructional contexts, there is more prolonged, frequent and focused exposure to unfamiliar words.

1.6.1 Fast Mapping and Quick Incidental Learning (QUIL)

The term 'fast mapping' was originally coined by Carey (1978) to account for the rapid rates of vocabulary acquisition in young children. The term describes the initial phase of word learning in which normally developing children acquire, from very minimal exposure, a template for a new word in memory which serves as a basis for later more extended learning.

In their classic experiment Carey and Bartlett (1978) introduced children aged three to four years old to the new word "chromium" to denote the colour olive green. Prior to the experiment most of the children had called this colour "green". Given a choice of two coloured trays (blue and chromium), the child was asked to "Bring the chromium one, not the blue one". Although the linguistic and non linguistic context provided information about the new word's meaning, the child's attention was not explicitly directed to it. In fact the task could be completed successfully by attending to the part of the instruction which stated "not the blue one". Six weeks later, there was evidence from children's production that changes had occurred in their lexicons as a result of their exposure to the word 'chromium'. Eight of the fourteen children no longer called the 'chromium' items green, as they had previously. Instead they either said they did not know or used another colour word which was not consistently used to refer to a colour. This suggested that changes had begun to occur in the children's conceptual and lexical domains.

The term Quick Incidental Learning (QUIL) used by Rice and her colleagues in a series of studies (Oetting, Rice, & Swank, 1995; Rice, Buhr, & Oetting, 1992; Rice, Oetting, Marquis, Bode, & Pae, 1994) has aspects in common with 'fast mapping'. This term refers to the initial stage of word learning and to the child's capacity to acquire at least a partial meaning of a new word. Rice views it as a more challenging task than 'fast mapping' however, because children are usually exposed to a greater number of new words, with no explicit instruction given to help them learn. Thus in studies where QUIL is expected, the environmental support to help the child link word and meaning is minimal.

The fast mapping and related QUIL paradigms have allowed useful comparisons of word learning to be made between children with SLI and those with normal language development.

In an early study, Dollaghan (1987) demonstrated quite specific word-learning difficulties in children with SLI using the fast mapping paradigm. She compared the acquisition of one word "koob" by 11 pre-school children with SLI to a group of normally developing children of the same age. All the children with SLI had restricted grammatical development as measured by mean length of utterance but they varied greatly on tests of receptive and expressive vocabulary. 54% of the children had receptive vocabulary scores within the normal range and 27% had normal scores for both receptive and expressive vocabulary.

The experimental tasks consisted of exposure, comprehension, production, recognition and location and were devised to yield information on several aspects of 'fast mapping' skills. In the exposure task the children were asked to hide two familiar objects and then the "koob", an oddly shaped white plastic ring. In the comprehension task they were required to select the object when named from an array of two familiar, and two unfamiliar objects and the "koob". In the production task the children were asked to name the "koob". If unable to produce the name, they were asked to identify the correct pronunciation from a choice of three nonsense syllables which included the correct label.

Dollaghan found that the main difference between the groups' performance was on the production task where seven children with normal language development managed a completely correct response compared with only one child with language impairment. She concluded that the children with language impairment were poorer in rapidly acquiring the phonological information for a new word but that the two groups were similar in other aspects of 'fast mapping'. The former was an important finding because it drew attention to the possibility that the phonological aspect of word learning might be particularly difficult for children with SLI (a point which will be returned to later).

However the claim that children with SLI were equally skillful at some aspects of 'fast mapping' seems somewhat premature given the limited extent of the study. In addition the fact that more than a quarter of the children had normal lexical development on testing may have bolstered the performance of the group with SLI.

Two studies (Oetting, Rice, & Swank, 1995; Rice, Buhr, & Nemeth, 1990), demonstrated difficulties in 'QUIL' in pre-school and school age children whose SLI included a receptive vocabulary deficit. The experimental procedure for both studies involved showing the children two short clips of cartoon video. In the course of these, 20 new words - five object words, five action words, five words for attributes and five words denoting affective states were introduced, mostly five times each, in a voice-over narrative. The experimental words coincided as far as possible with the referent on screen but no attempt was made to specifically draw the child's attention to the new words. Rice claimed that the videos provided a fairly natural opportunity for word learning and one from which normally developing children had already demonstrated the ability to learn new words (Rice et al., 1990).

Assessment was carried out before and after viewing and required the children to select a picture named from a set of four pictures taken from the video. The gain in word comprehension made by the children with SLI from pre to post viewing was compared to that of children with normal language development. This measure was taken to reflect the child's capacity to learn word meanings.

In the study of pre- school children, (Rice et al., 1990) those with language delay whose mean age was 59 months, were compared to two groups of children with normal language development. The first control group was matched for age, and the other for mean length of utterance in morphemes. Although the children with language delay demonstrated some fast mapping, the number of words they gained was significantly poorer than either the chronological age matched or language age matched control group. The authors concluded that the inferior word learning in children with language impairment was "strongly implicated as a causal factor" for their limited vocabularies.

In a later study (Oetting et al., 1995), these results were replicated to some extent in older children with SLI, aged 6-8 years. Using the same methodology as previously, the group with SLI was found to learn significantly fewer words than chronological age matched controls. Furthermore when their gain in learning was compared to young normally developing children from a previous study, the amount learned by the group with SLI was only slightly better than that reported for normally developing 3-year olds.

1.6.2 Instructional Contexts

In studies where an instructional procedure is used, adults are interactive and supportive in helping the child learn new words. Also the children generally encounter the new words over a greater number of experimental sessions in the instructional paradigms than they do in 'fast mapping' or QUIL studies.

Two studies using an instructional context (Leonard et al., 1982; Schwartz et al., 1987) suggested that children with SLI with limited vocabularies and at the single word stage in their expressive language, had strengths and weaknesses in their ability to learn new words for objects and/or actions. Pre-school children between 2;8 years and 4;2 years were compared to language age matched controls and a variety of findings emerged.

Firstly, and to the authors' surprise, children with language impairment were often similar to controls in the amount of words learned and sometimes in their pattern of lexical learning. This was apparent when Leonard et al. (1982), exposed two groups to new object and action words. Children with language impairment learned as many new words as language-age matched controls. Both groups learned more names for objects than actions and both were more likely to produce words containing sounds already in their repertoires than words with sounds that were absent from their phonologies.

Differences also emerged. On the positive side children with SLI sometimes learned more words in a particular category. In the study by Leonard et al. (1982), they surpassed their controls in the acquisition of action words while in the study by Schwartz et al. (1987) children with language impairment learned more names of objects which were presented with no accompanying action than the younger children with normal language development.

On the negative side, the performance of language impaired children was sometimes less competent in processes which might affect their vocabulary development. For example they were poorer than the controls at extending new object words to other unnamed exemplars in the same group (Schwartz, et al. 1987). This may suggest that children with SLI are poorer in generalising the use of new words to items which, though different, share characteristics with the taught word.

A much more recent study of word learning in pre-school children (4;0- 5;11years) with SLI concurred to some extent with the conclusions in the Leonard and Schwartz studies. Kiernan & Gray (1998) compared word learning by 30 children with SLI to age matched peers in a supported learning context. This was an instructional approach designed to facilitate word learning in pre-school children with SLI. As in the studies by Leonard and his colleagues, the words were introduced in play with an adult. Following four 30 minute sessions, the groups were compared for the number of words produced to criterion (75% correct on two consecutive days). Results suggested that, while as a group the children with SLI produced significantly fewer words correctly than their age matched controls, 73% of the children produced as many words as the age matched controls. Therefore according to Kiernan & Gray (1998) only a subset of children with SLI (n=8) were poor word learners and produced fewer words than any of the controls. However even these children demonstrated comprehension of 81% of the words they could not produce and the SLI group, irrespective of the number of words learned, did not take more trials to learn to produce a word.

The finding by Kiernan & Gray (1998) that the majority of children with SLI in this study did not have word learning difficulties was surprising, even though the results from the group with SLI <u>as a whole</u> were more in line with expectations. In interpreting these results it should be borne in mind, however, that the mean scores of the SLI group on prior tests of expressive and particularly receptive vocabulary were well within the normal range. This suggested that the majority of these children's SLI did not include lexical deficits. Consequently the fact that the majority demonstrated similar word learning to the control group may be less surprising. This position however is rather difficult to reconcile with the authors' finding that vocabulary test scores and word learning scores were not significantly correlated.

In summary, depending on the study, children with SLI may be similar to, better, or poorer than normally developing peers when learning new words. Possible reasons for this lack of consensus will be discussed in the next section.

1.6.3 Possible reasons for conflicting findings

The question of whether children with vocabulary deficits have word learning difficulties has not been conclusively settled by any of the work described so far. The possible reasons for these conflicting findings may be found in the variations in methodology which include:

- the contexts for word learning provided
- the sample of children with SLI studied
- the type of control groups included.

These will be considered in turn.

1.6.3.1 The contexts for word learning

An obvious difference between the studies is the context in which the words were presented. These differ in the amount of exposure given to each word, the number of sessions over which the new words are encountered, the types and number of words and the manner in which the words are presented.

A particularly important variable may be the amount of support given to the child for learning the words. In the QUIL studies this was minimal. Children watched a video with a voice over story. Although the text containing the experimental words coincided with video frames in which the referent for the word was depicted, the referents for the words were not isolated in the video scenes. Furthermore the words did not occur in the same place within sentences, and unlike fast mapping, contrasts with familiar words were not introduced to make meanings more explicit. Thus there was little support for learning and children with SLI performed poorly.

In studies where an instructional paradigm was used children were given more help to learn the experimental words. For example in the research by Kiernan & Gray (1998) they used an instructional approach designed to help children with SLI learn words successfully. The techniques included: labelling the object and describing its use when the child's attention was focused on the target word's referent, asking the child to repeat the experimental words, and feedback about the child's production and comprehension. While as a group, children with SLI performed more poorly than their peers, these authors pointed out that in this instructional context the majority of children with SLI performed within the range of the normally developing children.

A tentative conclusion from this work and also from that of Leonard et al. (1982) is that problems in word learning in children with SLI may be alleviated or even overcome by modifications to word learning opportunities. However because studies also differ in the sample of children with SLI studied and in the choice of control groups, such an emphasis on context may be oversimplistic.

1.6.3.2 The sample of children with SLI

As stated in section 1.1., children with SLI are not a homogeneous group and not all of them have vocabulary deficits. When studies of word learning are scrutinised, it is apparent that the criteria for selecting children with SLI vary. In some studies (e.g. Oetting et al., 1995; Rice et al., 1990) each individual child with SLI had a standard score for vocabulary comprehension at least one standard deviation below the mean on formal testing. In others (Dollaghan, 1987; Kiernan & Gray; 1998), the children were more heterogeneous with respect to their vocabulary scores. In the study by Dollaghan, children's scores for receptive vocabulary varied from within the normal range to more than two standard deviations below the mean and there was also considerable variability in their expressive language scores, e.g. three of the eleven children performed above the 50th centile while another three performed below the first. In the study by Kiernan and

Gray (1998) there were also children who had test scores in the normal range, and although individual children performed poorly on tests of expressive and receptive vocabulary, overall the group with SLI had a mean score within the normal range for both receptive and expressive vocabulary. If poor word learning does indeed underlie the various vocabulary deficits seen in children with SLI, it is likely that groups where the children have better scores for vocabulary will be better at word learning than groups where all the children have a vocabulary deficit.

However even when only children with vocabulary deficits are studied, such as in the studies by Leonard et al. (1982) and Oetting et al. (1995), conclusions vary. This may be due to the context (as we have seen earlier) or to the choice of control groups.

1.6.3.3 The type of control groups

In some studies (Leonard et al., 1982; Schwartz et al., 1987) the design has only included language age matched controls. In others only chronological age matched controls have been used (Dollaghan, 1987; 1993; Kiernan & Gray, 1998) whereas in the study by Rice et al. (1990) there were both age and language age matched comparison groups.

To establish that children with SLI have word learning difficulties they should do less well than children of the same age with normal language development. However the latter group will usually be more proficient in one or more aspects of language development. It then becomes difficult to ascertain the reasons for poor word learning. It may simply be that the group with SLI have word learning skills which are appropriate for their overall level of language development. If a control group matched for language age is included, this methodological problem is addressed. However conclusions drawn from comparing children with SLI with language age matched controls are also problematic because children in the latter group are inevitably younger. This in turn introduces the possibility that a better performance by the children with SLI may have been bolstered by superiority in other areas of development which might affect word learning. In the study by Leonard et al. (1982) this point was conceded in relation to the surprisingly good performance of the children with SLI who were older and more advanced in their cognitive development than the controls.

Conflicting findings suggest that further study of word learning would benefit from a careful choice of experimental and control groups. Furthermore the discrepancy between learning in more supported contexts versus those which require incidental learning may be addressed by studying more than one context for word learning in the same group of children. In the experimental design of Study 2 (see chapter 5), the study of word learning is extended to address such methodological limitations. One aim of this research therefore, is to investigate whether children whose SLI includes a vocabulary deficit have intrinsic word learning difficulties.

1.7 The nature and source of word learning problems in children with SLI

Information about the nature and source of word learning deficits provides a basis on which to design remediation and is therefore an important motivation for research in this field. In their studies of QUIL in children with SLI, Oetting et al. (1995) endorse this position by stating that "a primary reason these children have been included in the QUIL studies has been for intervention purposes; if the nature of the difficulties facing these children can be understood, curriculum and instruction may be improved" (p.435).

1.7.1 Explanations for poor QUIL in children with SLI.

It will be recalled that Rice and colleagues demonstrated a deficit in the initial phase of word learning in children with SLI. To explore the reasons for this, a series of studies (Oetting et al., 1995; Rice et al., 1992; Rice et al., 1990; Rice et al., 1994) was carried out which considered the processes involved in fast mapping/ QUIL. These were guided by the following description of the underlying skills, " attention, identification of a novel word, a quick assessment of the linguistic and non-linguistic context for a probable meaning, entering the probable meaning into the appropriate slot in the lexicon and storage for immediate or later use." (Rice et al, 1990:p.33).

The ability to identify a novel word in the stream of speech could be affected by a child's ability to segment the target word or influenced by the child's knowledge of grammar and vocabulary. In a study by Rice et al. (1992) the first of these potential explanations was specifically addressed and discounted. Using the video paradigm described in section 1.6.1., they found there was no significant difference between children with SLI who heard the narrative with pauses before the target new words and those who heard the story with no pauses.

It was hypothesised that the ability to deduce and acquire meaning during the initial phase of learning might rely on existing lexical knowledge. However the role of current vocabulary was also dismissed in a number of studies (Kiernan & Gray, 1998; Rice et al., 1990; Rice et al., 1992; Rice et al., 1994) because no association was found between the level of children's receptive vocabulary and their word learning. This is not a universal position however. In a study of children with normal language development (Gathercole, Hitch, Service, & Martin, 1997), the extent of a children's vocabulary was significantly associated with how easily they learned new words. Furthermore Robbins and Ehri (1994) found that the extent of 5 and 6 year old children's vocabulary growth following a story was related to their prior vocabulary knowledge. Children with bigger vocabularies learned more words than those with smaller vocabularies.

1.7.1.1 Poor syntactic bootstrapping as a cause of word-learning problems

Research on children with normal language development has shown that even quite young children can make use of cues from syntax to help them infer aspects of words' meaning (Taylor and Gelman, 1988; Bloom and Kelman, 1995). This capacity to use grammar in word learning has been described as 'syntactic bootstrapping' by a number of authors including O' Hara and Johnston (1997) and Rice et al. (2000). Given that the language of children with SLI may be characterised by poor grammatical development, this has been considered a possible explanation for their word learning difficulties. As in some previous areas of research into word-learning difficulties however, the role of poor syntactic bootstrapping in causing word-learning problems in children with SLI is still unclear.

One way to contemplate the effect of grammar on word learning is to look at the evidence where children with SLI have been compared with controls matched for Mean Length of Utterance (MLU). MLU gives an indication of the grammatical complexity of children's expressive language and if limited grammatical development was implicated in poor word learning, we would expect children with SLI and MLU matched controls to perform similarly in word learning experiments.

As yet however the evidence remains equivocal. For example in an early study by Rice et al. (1990) in which new words were introduced via stories about video cartoons, the MLU controls learned more words and had significantly higher scores on the post-viewing test of comprehension than children with SLI. This suggested that limited grammatical development did not explain inferior word learning in the SLI group. In a later study however Rice et al. (1992) did not find that children with SLI and controls matched for MLU differed significantly in their word learning scores, a result which might suggest that word learning in the SLI children was constrained by their limited grammatical development.

The latter position has gained some support from more recent research by Rice and her colleagues. In a study in which the frequency with which new words was presented was systematically varied across conditions, Rice et al. (1994) suggested that the complexity of grammatical information might affect the retention (i.e. storage) of words. They presented children with a video in which four new nouns and four new verbs were introduced 10 times each. Results indicated that verbs were at higher comprehension levels than nouns for both the SLI children and age matched controls. However when tested again one to four days later, children with SLI, but not their age matched controls, lost the advantage for verbs though scores for retention of nouns in the children with SLI remained the same as at post test following the video. Examination of the individual verbs showed that they differed in the extent to which they occurred in the past tense form.

Rice et al. surmised that the retention of new words may be affected by the complexity of the grammatical information children are required to store.

Most recently of all Rice et al. (2000) addressed the notion that limited grammatical development in children with SLI might affect their acquisition of new words. These authors investigated the role of determiners within the noun phrase in helping children understand novel nouns (particularly whether these were count nouns such as a 'button' or mass nouns, such as 'water').

20 five year olds with SLI and poor receptive vocabulary were compared with two control groups, one matched for chronological age and one matched for MLU. Within each group, children were randomly assigned to either the neutral or cued syntax condition which used the same eight short video clips. Each clip depicted the referents for a pair of novel words, one count noun and one mass noun. In the cued syntax condition the sentence accompanying the video clips provided syntactic information to help the child correctly assign the count noun to the count item and the mass noun to the mass item e.g. "I found a keelwug and some blick". In the neutral context however the sentence provided no such clues e.g. "I found the keelwug and the blick".

After each video clip, children's understanding of the new count and mass terms was tested on a picture comprehension test. When the children who had had the cued condition were compared with those who had had the neutral condition within each group, there was only a difference between conditions for the age matched controls suggesting that only they were able to use the syntactic information to learn the words. There was no difference between neutral and cued conditions in either the MLU controls or the children with SLI.

Analysis of the errors suggested however that the SLI and MLU groups had different reasons for their mistakes. Most of the children with SLI appeared to have remembered the objects from the video however they did not use the syntactic information from the sentence to choose the correct referent. Conversely in the MLU group, more than half of the children had difficulty remembering which items had been specifically introduced in the video and therefore chose pictures which had not been named in the film clip. Because the children with SLI were much poorer than both control groups at using determiners in their spontaneous speech, Rice et al. suggested that their limited grammatical knowledge might have affected their ability to use syntactic cues in learning the meanings of new words.

1.7.1.2 Repetition and word learning deficits

Rice et al. (1994) also studied the role of frequency of input in word learning. The assumption was that if children with SLI could learn as well as their peers, given enough exposure to new words, their difficulties might not be in what Rice et al. called "the underlying cross-situational mechanisms". By these they meant the ability to map a novel word onto a novel referent without specific adult direction.

Children's quick incidental learning of four nouns and four verbs introduced via cartoons with narratives was compared in those with SLI and two control groups. One control group was matched for age, the other for language age. The conditions varied in how frequently the words were repeated. When words occurred three times (the F3 condition), a group of children with SLI performed more poorly that the age matched controls and similarly to language age matched controls. However when words were repeated ten times (the F10 condition), another group of children with SLI was better than their language age matched controls and similar to chronological age matched controls in their amount of learning.

Rice therefore proposed that a "minimal input constraint", i.e. a threshold of repetition under which learning does not take place, might operate for younger children and those with SLI. On the plus side, the study suggests that provided the words occur frequently enough, children with SLI appear to have a robust ability for QUIL. However if in the course of development they do not improve and come to learn from similar levels of exposure as their peers, this minimal input constraint might lead to a widening gap between age and level of vocabulary knowledge in children with SLI.

1.7.2 Processing constraints and word learning deficits

Yet another explanation, that processing constraints might compromise word learning, was hypothesised by Ellis Weismer & Hesketh (1993, 1996). In the first of these studies, the effect of rate of speech, stress and gesture on word learning was investigated in a small group of children with SLI aged five to six years old, compared to children with normal language development. With regard to rate, both groups of children were poorer in their comprehension and production of novel words presented at a fast rate than at slower rates. However although there was a trend suggesting that learning was affected more detrimentally by increased rate in children with SLI than in children with normal language development, this did not reach statistical significance. With regard to stress, there was a trend for children with SLI to benefit from the effect of emphatic stress compared with neutral stress and both groups benefited from gestures accompanying the nonwords. Thus this study (because of the lack of interaction effects) was not particularly illuminating with regard to the type of manipulations and therefore the type of processing constraints that were unique to the SLI group. However trends in the data suggested possible avenues for further investigation.

In the later and larger study Ellis Weismer & Hesketh (1996) again studied the effect of speaking rate on the ability of children with SLI to learn novel words. A task where words were presented at slow, normal and fast speaking rates was used. The SLI group was particularly poor at producing words that had been presented at fast speaking rates. This was in comparison to both mental age and vocabulary matched peers. The authors therefore suggested that children with SLI have processing limitations for rapidly presented material which affects their ability to learn new words.

1.7.3 Phonological explanations for word learning difficulties

In some research a rather different approach to understanding the nature and source of word learning and vocabulary deficits (from those described above) is taken. This alternative implicitly or explicitly considers the quality of the child's underlying lexical representation in terms of semantic and phonological information, and has opened up a promising avenue of enquiry. It will be seen however, that in relation to children with SLI phonological explanations have received relatively more attention than semantic explanations.

Evidence that vocabulary and word learning deficits may stem from problems acquiring a phonological representation for a new word come from a variety of sources including some word learning studies where there is a focus on phonological learning, exploration of naming difficulties in children with dyslexia, single case studies using the developmental cognitive neuropsychology approach and work on phonological memory and vocabulary development.

1.7.3.1 Phonology in word learning studies

It will be recalled that the fast mapping study by Dollaghan (1987) referred to in section 1.6.1 found that children with normal language development mainly differed from those with SLI in their ability to acquire phonological information. As already discussed, this study's limited methodology did not allow us to confidently exclude difficulties acquiring meaning. However, by highlighting the poor acquisition of phonological information it made an important contribution to current thinking about the cause of word learning problems.

In a larger and more extensive piece of research, Haynes (1982) presented evidence for her opinion that poor vocabulary development in children with SLI occurred as the direct result of aspects of their impaired phonological abilities. She compared the acquisition of new words from three short stories by children with SLI aged nine years with chronological age matched and vocabulary age matched controls. The assessment consisted of two recognition tasks. In the first, children had to identify the correct pronunciation of the word from a series of four words which varied in the degree of similarity to the correct form. In the other recognition task (concept acquisition), children were asked to choose a picture of a word from a selection of four pictures appearing in the story.

The children with SLI performed poorly on both tasks. When asked to select the correct pronunciation for the target word, they identified significantly fewer correct items compared to both age matched and vocabulary age matched peers. In addition they made significantly more random errors (selecting alternatives least like the target words in pronunciation). On the concept acquisition task, the SLI children chose fewer pictures correctly than either the age or vocabulary age matched controls. An analysis of variance showed that the difference among the three groups was significant. However because no pairwise comparisons appear to have been carried out subsequently, it is difficult to know whether the differences were significant when the SLI group was individually compared with one or both control groups.

In addition to the poor performance of the SLI children on both recognition tests, a positive correlation was found between their performance on the phonological task and the task assessing acquisition of the concepts. Even though the direction of the effect could have been the other way round, Haynes took the view that the ability to retain meaning in the SLI group may have been compromised by the lack of phonological information with which to associate it.

Both these studies emphasise phonological learning deficits and they are important in raising awareness of the importance of phonological representation. However the limited exploration of semantic representations in both studies may mean that difficulties of this nature have been overlooked. This limitation will be addressed in the research carried out for this thesis.

1.7.3.2 Naming deficits in children with dyslexia: A phonological explanation

The fact that a number of children with SLI go on to have reading difficulties makes it appropriate to consider whether insights can be gained from work on naming deficits in children with dyslexia.

Difficulties with naming pictures accurately and speedily, compared with their peers who read normally, are a characteristic of many children with dyslexia (Katz, 1986; Murphy, Pollatsek, & Well, 1988; Snowling, van Wagtendonk, & Stafford, 1988; Swan & Goswami, 1997; Wolf & Obergon, 1992). In researching the cause of these difficulties, semantic and phonological reasons have been considered. For example, the child's difficulty with naming a picture could be a result of generally impoverished vocabulary levels. In this case the child would lack information about the meaning and the pronunciation of the item. Alternatively however, the child may have a more specific difficulty with the quality or retrieval of phonological information stored.

The latter has been implicated as the reason for dyslexics' naming difficulties in a number of studies. In addition there have been some insights into which aspect of processing might constrain the acquisition of a phonological representation.

In a study by Katz (1986), 33 children aged eight years were divided into groups of poor, average and good reading ability. Firstly Katz found that naming skill was significantly associated with reading ability. However more importantly for understanding the source of these difficulties, the poor readers' naming difficulties were not simply because they had smaller vocabularies. When scores were adjusted to remove those items which were not in their vocabulary (because they were unfamiliar or failed in the comprehension test), the strength of the association between naming scores and reading ability was similar. In addition the poor readers had more difficulty naming longer and/or low frequency words. Katz therefore suggested that difficulty with representing and/or processing phonological representations was a possible explanation for naming difficulties in children with reading disabilities.

The suggestion that the underlying difficulty is phonological rather than semantic in dyslexic children with naming deficits has been supported by research by Snowling et al. (1988) and by Swan and Goswami (1997). In the first of these studies, Snowling et al. established that the naming difficulties evident in a group of children with dyslexia were not due to a lack of semantic knowledge about the items they were unable to name.

Dyslexic children and normal readers matched for age and their ability to give verbal definitions of words on the British Ability Scale, were given a picture naming test followed by a receptive picture vocabulary test. The dyslexic group was significantly poorer on the picture naming test but performed similarly to the normal readers on the picture selection test. Like Katz the authors posited a phonological explanation for these difficulties. In their words "..we favour the argument that dyslexics are slow to acquire precise phonological representations for words which are nonetheless semantically represented"(p.80). This statement therefore stressed the acquisition rather than the retrieval of phonological information. (In fact in a previous experiment in the same study, the authors had established that the dyslexics' naming speed for items they knew was similar to normal readers'.)

A phonological explanation for naming deficits in developmental dyslexia was also put forward by Swan & Goswami (1997). A number of findings contributed to this conclusion and also provided insight into the possible source of these children's naming deficits. The study compared four groups, children with dyslexia, poor readers with overall low performance on IQ tests, age matched and reading-age matched controls. Although across all the groups there was a highly significant relationship between reading and accuracy of picture naming, the dyslexic group was more able than the others to select on demand, pictures of the items they had been unable to name. According to Swan and Goswami (1997), this pattern of results might indicate that the naming deficit in the dyslexic group could be partly due to problems retrieving names that are present in their vocabulary store. The notion that it was the retrieval of phonological information that was implicated was supported by the fact that the children with dyslexia made a significantly greater percentage of phonological nonword errors than the other groups and also their errors were very similar phonologically to the target names.

Having postulated a phonological retrieval explanation for naming deficits in dyslexia, the authors go on to suggest that the difficulty might be with processing the phonological form of the word for naming or with laying down the phonological information in the first place. They therefore altered their terminology and suggested a "phonological specification/retrieval hypothesis" to explain naming deficits. They supported this with other findings from their study. For example they demonstrated dyslexics' uniquely greater difficulty with long versus short words.

Overall this study added weight to the notion that dyslexic children's naming difficulties are not merely a consequence of a generally impoverished vocabulary and confirmed the supposition that phonological difficulties underlie their naming difficulties. However one is left in some confusion about whether the source of these difficulties is with acquiring or retrieving a phonological representation for naming. In explaining their results however these authors seem to favour the encoding explanation.

Certainly some earlier work by Snowling et al. (1986) lends support to an acquisition rather than a retrieval deficit. This study looked at speech processing in dyslexic children and age and reading matched controls. The groups were compared for their repetition of real and nonsense words with and without noise masking. In the presence of masking, all three groups performed similarly. However differences in repetition between them were apparent when word type was considered. The children with dyslexia were poorer than age matched controls and similar to reading age matched controls when repeating infrequent real words, but poorer than both control groups when repeating nonwords. This pattern of results was interpreted using a simple information processing model which expands the model described by Ellis & Young (1988) for recognising and producing familiar words.

When familiar real words are repeated, firstly phonemes in the speech wave are identified (auditory analysis) and transmitted to the auditory lexicon where a match for the incoming word is sought. If a sufficiently good match is found among the words already stored, the word can be repeated using a stored articulatory pattern accessed via the word's meaning. Consequently, for familiar words the individual can rely on an existing motor programme for saying the word. A rather different situation exists for repeating nonsense or unfamiliar words for which Snowling et al. propose a nonlexical route. Although this route also includes auditory analysis there will be no match for the nonword stored in the auditory lexicon. Therefore instead of accessing an already existing articulatory pattern via the word's meaning, a new motor programme for saying the word must be compiled via auditory perception and segmentation of the incoming nonword. In Snowling at al's view, the dyslexic children's difficulty with nonword repetition was not due to auditory perceptual difficulties because all three groups performed similarly when masking noise was present. In addition the authors did not identify speech problems to account for difficulties in repetition. Instead they considered that the difficulty in repeating nonwords was most likely due to difficulties with segmentation. This they suggest might affect the acquisition of the phonological component of the lexical representation for a word. Consequently children with dyslexia may be similar to age matched normal readers in their knowledge of word meanings but the phonological representations associated with these meanings will be imprecise.

The work described above extends and complements our understanding of word learning deficits in children with SLI by providing insights into the nature and source of naming deficits in children with dyslexia. Firstly it confirms the importance of phonological information in naming, and in dyslexic children it appears to exclude poor semantic representations as a reason for their naming difficulties. Secondly it suggests that problems with encoding and/or retrieval of phonological information may be responsible for the inability to name pictures which can be accurately selected. Thirdly it describes a possible way in which the laying down of precise phonological information might be disrupted, via an information processing model of word and nonword repetition.

While these are important contributions, it would be inappropriate to assume that phonological explanations are the only possible reason for the lexical problems of children with SLI. SLI is usually characterised by a wider range and greater severity of spoken language problems than is found in dyslexia. It is therefore unlikely that lexical problems associated with SLI will have such a clear cut explanation. Consequently in groups with SLI we need to look at both phonological <u>and</u> semantic explanations for their lexical limitations. It will become apparent in the next section, when models of information processing are used to explore the cause of lexical problems, that semantic and phonological factors emerge as possible reasons for lexical problems in children with SLI.

1.7.4 Studies of lexical processing in children with vocabulary deficits

According to Bryan (1995) there has been increasing interest in adapting models of single word processing, derived from work with adults whose language is unimpaired and those with acquired language disorders through brain injury or disease, to explore the underlying deficits in children with developmental language impairments (Bryan & North, 1994; Chiat, 1993; Constable, Stackhouse, & Wells, 1997; Lewis & Speake, 1998). Applied to vocabulary deficits, this approach attempts to answer questions about the source of lexical difficulties in individual children based on models of word recognition and production.

Characteristically the models include three main components, <u>input processing</u> which analyses the incoming word, the <u>representation</u> which stores phonological, semantic (and other) information to recognise, understand and produce the word, and <u>output processing</u> which allows the word to be produced from the stored information.

Children are assessed using 'tapping' tasks. These are assessments which are thought to 'tap into' a particular level of processing and indicate whether a child has problems. For example to investigate whether children have difficulty with auditory analysis (input processing) they may be asked to listen to pairs of nonwords and decide whether these are the same or different. To tap into their semantic representations children may be asked to answer questions about the meanings of words. Using this approach, researchers try to explain an observed clinical picture according to a particular profile of processing skills.

Studies using this approach have often been carried out by clinicians working with individuals or pairs of children. While this tendency to use single cases restricts our ability to generalise findings to the population of children with lexical deficits, it has nonetheless been influential in raising awareness of the range of possible underlying problems and some of the methods by which these can be explored. A brief review of the work using this approach provides an indication of the range of findings from studies of this type.

Bryan & North (1994) carried out single case studies of two six-year old children: Greg a boy with marked receptive and expressive vocabulary problems; and Anne Marie, who had word retrieval difficulties. These authors based their investigations on the model of single word processing proposed by Ellis & Young (1988) which includes the following components: auditory analysis (input), the auditory input lexicon, the semantic system and the speech output lexicon (the representation), and the phoneme level and speech (output).

Using tasks which tapped into the various components of the model, different profiles emerged. According to the authors, Greg was poor at auditory analysis, e.g. he had difficulty clapping out the syllables in nonwords and found it hard to judge whether nonwords were the same or different. They proposed that Greg's difficulties with auditory analysis would have a 'knock on' effect on his ability to acquire accurate phonological representations for new vocabulary and that this in turn would affect his ability to acquire semantic information and his pronunciation.

Although Anne Marie also had some difficulties on tasks tapping auditory analysis, she was more proficient than Greg and auditory analysis was not viewed as her main area of difficulty. Instead, the authors suggested that her problems were mainly in the semantic system which they suggest stores word meanings and associations. She had difficulty answering questions about the meanings of words e.g. " Do pavements sprinkle?" and she could not provide a list of words within a given category.

Lewis & Speake (1998) also reported on a pair of children, Rosie and Richard, who had lexical problems. As with the previous study, phonological and semantic processing skills were "tapped" and profiles of processing described. Richard, aged 8 years, had difficulty with a variety of semantic tasks. These included problems deciding whether the name of a picture was correct (e.g. when shown a comb, he was asked if it was a brush), and difficulty producing items in a given category and in explaining why pictures went together. Richard also had problems with phonological tasks. He was inaccurate in discriminating between pairs of nonwords (auditory analysis) and he was poor at detecting and generating rhyme. The authors suggested that he had underdeveloped and underspecified semantic representations and difficulties in processing and accessing phonological information.

Rosie, on the other hand, was much more proficient than Richard on tests of phonological processing but like Richard found it hard to describe associations between words and to produce items within a given semantic category. She was also confused by words whose meanings were closely associated e.g. knit/sew, catch/throw. Her difficulties were mainly evident on tasks which tapped semantic processing and it was suggested by the authors that her semantic system was underspecified.

Returning to the assertion that phonological difficulties in particular might cause vocabulary deficits, a case study by Constable et al. (1997) of seven year old Michael took this notion a step further by attempting to directly link the phonological processing deficits they observed to the child's word finding problems. The authors carried out a two stage investigation. In the first stage they tried to establish if the source of Michael's word-finding deficit was mainly phonological or semantic. Three semantic assessments were administered. These were: the Pyramids and Palm Trees test (Howard and Patterson, 1992) which assesses an individual's ability to associate two pictures on the basis of semantic information, and the Word Association and Word Classes subtests of the Clinical Evaluation of Language Fundamental-Revised (CELF-R) (Semel Wiig and Secord, 1987). These assessed the ability to produce words within a given semantic category, and the ability to identify two words from a choice of four which are associated in meaning, respectively.

From the results of these tests the authors concluded that the deficit underlying Michael's WFD was not semantic. With the exception of his poor performance on the Word Classes test, which they considered might be explained by memory or phonological processing limitations rather than semantic difficulties, Michael's performance on semantic tests was satisfactory. Conversely Michael performed poorly on both phonological tests. He had difficulty discriminating between pairs of nonwords which differed in phoneme sequence (Bridgeman and Snowling, 1988), a difficulty which was similar to difficulties observed in a group of speech disordered children studied by these authors. In addition his ability to produce rhyming words was much poorer than five year old children with normal language development. The authors concluded that it was more likely that the phonological processing deficits were responsible for Michael's WFD and proceeded to explore this in the next stage of their investigation.

In the second stage, the authors presented a series of five different phonological processing tasks involving the same words. The tasks were naming, auditory lexical decision (ALD) in which Michael had to decide which words in a list were real, and which were nonwords, ALD with pictures, ALD with pictures and using his own pronunciation errors as the nonwords, and real and nonword repetition. Michael's performance on these tasks was compared with two control groups, one matched for chronological age and one for level of receptive vocabulary development. In addition Michael's own performance across tasks was compared and the level of breakdown suggested, based on an information processing model. In common with the model of word recognition and production already outlined (Ellis and Young, 1988) this model included input processes, representation (semantic representation, phonological representation and the motor programme) and output processes.

Based on the results from the second investigation and interpreted in the light of the above information processing models, the authors suggested two main reasons for Michael's word-finding difficulty. Firstly they suggested that there were faulty links between his semantic representations and motor programmes. As evidence for this they cited a dissociation between his ability to spontaneously name pictures and repeat the same words. His relatively poor performance on the former when compared with the latter was the basis of this suggestion because naming, unlike repetition, requires the motor programme to be activated via the semantic representation.

They also proposed that Michael had underspecified phonological representations and that these were implicated in his word-finding difficulty. On auditory lexical decision tasks he rejected closely matched nonwords for items he had named accurately suggesting that his phonological representation for these words was accurate. However he had difficulty with auditory lexical decision tasks for pictures that he could not name, suggesting that his phonological representations for these items were not sufficiently well specified to reject inaccurate pronunciations of the words.

This body of work on information processing models has influenced clinical assessment and has taken a more analytical approach to understanding vocabulary difficulties than has previously been attempted. On the plus side the work has highlighted the fact that both semantic and phonological processing deficits can occur in children with vocabulary deficits and that these may be implicated in their difficulties. However the extent to which this approach has contributed to our understanding of lexical deficits is limited by a number of factors which include:

- Difficulty in generalising findings from single case studies to a range of children with vocabulary deficits.
- Tapping tasks which attempt to elucidate an area of defective processing may be confounded by other task demands such as auditory memory.
- There is little normative data for assessing a child's performance on tapping tasks and hence their developmental application is limited.
- There is no evidence that difficulties identified on the tapping tasks cause the child's vocabulary deficit.
- The models are unbalanced when applied to acquisition of a lexical representation because, on the input side they are based on models of word recognition which only consider phonological processing. This is evident in the following description of word recognition (Ellis and Young , 1988 p.144). "We propose that the first stage of

auditory word recognition performed by an early auditory analysis system attempts to identify phonemes in the speech wave. The results of this analysis are transmitted to the auditory input lexicon where a match is sought against the stored characteristics of known words. If the match is a good one, the appropriate recognition unit in the auditory input lexicon will be activated. It in turn will then activate the representation of the meaning of the heard word in the semantic system". While it seems reasonable to suggest that the phonological skills involved in word recognition may also play a part in acquiring a phonological representation for a new word, there is no concomitant explanation in models of word recognition to account for the acquisition of the semantic representation or for the way in which components of the lexical representations become linked.

- The models cannot accurately account for acquisition until the probable role of phonological memory in establishing a phonological representation of new words is included.

In addition to all the above, reservations about the application of models of adult processing to understanding developmental difficulties has been fully but constructively criticised by Bishop (1997).

1.7.5 Phonological memory and vocabulary acquisition.

In the last 12 years a great deal of research activity has focused on the role of phonological memory in acquiring new words. This has highlighted the need to consider poor phonological memory as an explanation for vocabulary deficits. Phonological memory is a component of the short term memory system first described by Baddeley and Hitch (1974). It is specialised for the retention of speech for short periods of time and is comprised of a store to retain phonological information, and an articulatory loop to refresh decaying phonological information by subvocal rehearsal. Phonological memory capacity changes with development particularly between the ages of four years and adolescence (Gathercole, Willis, Emslie, & Baddeley, 1992) although there can also be considerable variability among children of the same age.

The evidence that problems with phonological memory contribute to vocabulary deficits comes from studies of both adults and children with phonological memory deficits and from the longitudinal and cross-sectional study of the developmental relationships between vocabulary, word learning and phonological memory. With accumulated research however, it seems that phonological memory is mainly credited with a role in acquiring the phonological representation for new words, rather than in acquiring the semantic representation.

1.7.5.1 Studies of adults

A major insight into the underlying and important role of phonological memory in vocabulary acquisition first came from a study of a young Italian woman with acquired brain damage and a selective difficulty with phonological memory (Baddeley, Papagno, & Vallar, 1988). The patient PV, was compared to normal controls for her ability to remember the second word of a pair in a set of eight real word pairs. By the fifth time she heard the word pairs repeated, PV was able to recall the associated word. This rate was similar to controls. When unfamiliar Russian words were used as the second word in the pair however, PV performed much more poorly than controls and was unable to remember any of the associated words even after ten repetitions. The authors suggested that PV had difficulty with the temporary storage of phonological material and that this compromised her long term learning of the unfamiliar Russian words.

Subsequently the study of a graduate student (SR) with a developmental deficit in phonological memory (Baddeley, 1993) produced similar results to the case of PV. When required to learn a set of Finnish words associated with English words, the graduate student was much poorer than his fellow students. Like PV however he was similar to controls when required to learn pairs of familiar words.

The single case studies of PV and SR were important in demonstrating the co-occurrence of phonological memory deficits and difficulty learning new words thereby highlighting a possible causal relationship. Group studies of children with SLI and those with normal language development have added weight to this link. Research in this area has taken two main forms. Some studies have considered the developmental relationship between measures considered to tap phonological memory and existing levels of vocabulary in cross-sectional or longitudinal studies. Other research has looked at children's ability to learn new words and the link between this learning and measures of phonological memory. The evidence for phonological memory deficits underlying vocabulary problems in children will now be reviewed.

1.7.5.2 Longitudinal and cross-sectional studies

If phonological memory is important for vocabulary acquisition we might expect children with vocabulary deficits to have poor phonological memories. This was found to be the case when Gathercole & Baddeley (1990) studied a small group of children with SLI compared to age and language age matched controls. Of particular interest to this thesis is the fact that the average vocabulary level of the clinical group as a whole was 20 months below their age level on the British Picture Vocabulary Scale (short form) and only one of these six children had a deficit of less than one year for vocabulary. Results showed that the children with SLI were much poorer at repeating, in particular, longer nonwords than both control groups. Moreover their nonword repetition skills were much more delayed than either their vocabulary or reading ability.

Important information on the relationship between phonological memory skills and existing vocabulary also came from a longitudinal study (Gathercole et al., 1992) including data from 80 children over a four year period when aged 4, 5, 6 and 8 years. Over the four waves of the study, the relationship between measures of phonological memory and receptive vocabulary level on the British Picture Vocabulary Scale was analysed. At all four ages there was a significant correlation between measures of phonological memory and vocabulary development. However the strength of the link between the variables at eight years, though significant, was smaller. The data were also analysed using partial correlations in order to remove the possible influence of chronological age and intelligence on both variables. Again all partial correlations were significant suggesting that the link between phonological memory and vocabulary was not dependent on age or intelligence.

Finally crosslagged partial correlations of the longitudinal data were used to consider the direction of the relationship between phonological memory and receptive vocabulary development. This statistical technique compares the strength of the link between one variable (in this case phonological memory) e.g. at five years and the other variable of interest (vocabulary development) e.g. at six years with the strength of the link between these variables in the opposite order. The direction of causation is suggested by the larger of the two correlation coefficients.

These analyses suggested that between the ages of four and five years phonological memory does seem to drive vocabulary development and this was in keeping with the authors' claim that phonological memory has an important function in laying down the phonological representations of new words in memory. However the situation changed when pairs of scores at five and six, and six and eight years were considered. The strength of association was stronger in the direction of vocabulary to phonological memory.

Overall then, this study suggested that measures of phonological short term memory and vocabulary development were significantly related between the ages of four and eight years. However there was a suggestion that as children became older, the strength of the relationship was weaker. By the time the children were eight years old the correlation between Nonword Repetition, one of the measures of phonological memory, and vocabulary development was significantly lower than the corresponding ones at four and six years. Furthermore the study also suggested that as children became older the direction of causation in the relationship between phonological memory and vocabulary development changed.

If the relationship between vocabulary and phonological memory does indeed weaken with age we might expect that in even older children this relationship would no longer be significant. A more recent cross-sectional study of children aged 13-14 years (Gathercole, Service, Hitch, Adams, & Martin, 1999) however established that the relationship between phonological memory abilities and vocabulary knowledge persisted in older children. The links between two measures of phonological memory (digit span and nonword repetition) and tests of vocabulary development (receptive vocabulary, naming and knowledge of verbal definitions) were investigated in 60 children between 13 and 14 years old. A significant relationship was found between a composite score of the three vocabulary tests and both measures of phonological memory in these older children and it persisted even when the contribution of non-verbal ability was taken into account statistically. Although this confirms that the relationship between vocabulary development and phonological memory persists in much older children, the direction of the relationship was not addressed in this study and must therefore remain open to question given the results from the cross lagged correlations in the previous investigation.

1.7.5.3 Word learning studies

Three studies of children learning new words under experimental conditions have provided further evidence that phonological memory is important for acquiring the phonological aspect of new words. In particular a relationship between phonological memory and word learning is generally seen as more powerful evidence of a causal relationship than links between existing vocabulary levels and phonological memory.

In the first of these studies (Gathercole & Baddeley, 1990), five year old children were selected from a longitudinal study by the same authors (Gathercole & Baddeley, 1989). The children were divided into two groups according to phonological memory as measured by a test of nonword repetition. This resulted in a high repetition skills group and a low repetition skills group. Both groups were taught proper names (e.g. Peter, Thomas) for a set of four animals and four nonword names (e.g. Meton, Pimas) for a different set of four animals. Clear differences between the groups emerged. Children with high repetition skills were significantly faster at learning the non names but not the names than the group with low repetition skills. This reinforced Gathercole's view that phonological memory had a likely causal role in the acquisition of new words.

Subsequently some work by Michas & Henry (1994) concurred with this conclusion. Five year old children were again studied for their acquisition of new words in two different learning paradigms. In the incidental learning procedure one new word 'maroon' was introduced in a similar way as in the study by Carey & Bartlett (1978). In the instruction paradigm the children were given pictorial and spoken definitions of new words. Phonological memory was assessed by asking the children to repeat single nonwords (Nonword repetition) and by asking them to repeat lists of nonwords of increasing length (Nonword span).

The assessments of phonological memory were significantly linked to some measures of word learning from the instruction paradigm. There were significant correlations between measures of phonological memory and comprehension and especially production of the experimental words. Interestingly the children's ability to recall definitions and phonological memory were not linked. Furthermore the authors suggested that other factors such as environmental differences also played a part in vocabulary acquisition.

Another study, also with five year olds, is of particular relevance to whether phonological memory might be more strongly linked with different aspects of word learning. Gathercole et al. (1997) provided the children with four different word learning tasks which varied in the amount of novel phonological material to be acquired. These were the 'word-word task' where the child heard four pairs of real words and had to remember the second word of the pair when presented with the first, and the 'word-nonword' task which followed the same format as the word-word task. In each of the other two tasks children were presented with two nonwords and their associated definitions in a short statement. In the recall of definitions task the child was asked to recall the definition when provided with the nonword. In the recall of names task the child was asked for the nonwords when given their definitions. Of particular interest was whether the effect of phonological short term memory was more evident on tasks where greater phonological learning was required viz. the word-nonword task and the recall of names task. To this end, two measures of phonological memory, digit span and non word repetition, were correlated with scores from each of the word learning tasks. Results indicated firstly that there was no significant relationship between either measure of phonological memory and the word-word task where no new phonological learning was required. However phonological memory was significantly associated with the two learning tasks which required the greatest phonological learning. Non word repetition was also significantly correlated with a the recall of definitions which required some phonological learning presumably because children had to have acquired at least a partial phonological representation with which to associate the semantic information.

These findings were therefore in line with the hypothesis that phonological memory has a role in the acquisition of new words. Consequently one of the possible underlying reasons for vocabulary deficits is a problem with phonological memory .

1.7.5.4 Measuring phonological memory

While the strength of the evidence for the role of phonological memory in acquiring the phonological aspects of new words is powerful, this must be tempered by careful consideration of one of the principal measures of phonological memory used by Gathercole and colleagues. In many of their studies these researchers use the child's ability to repeat nonwords of increasing length. They favoured this as a purer (Gathercole & Baddeley, 1993) and more sensitive measure (Gathercole, Willis, Baddeley, & Emslie, 1994) of the capacity of the phonological loop than digit span because they felt it was not supported by existing lexical knowledge. However they now recognise this premise as erroneous and later accounts accept that nonword repetition might be mediated by prior lexical knowledge. For example in a study by Gathercole et al. (1997) they found that when the level of existing vocabulary was partialed out from correlation analyses, the relationships between digit span and phonological learning remained significant whereas the previous significant relationships between nonword repetition and phonological learning were eliminated. This suggested that phonological memory does seem to play a part in learning new words but so does the level of the child's existing vocabulary and that these two aspects of the child's development might be complementary.

Another concern about the use of nonword repetition (NWR) was raised by Snowling, Chiat, & Hulme (1991) who questioned its use as a measure of phonological memory. Instead they quite rightly draw our attention to the complexity of the task, which children can fail for a number of reasons. These include perceptual problems, difficulties with storing phonological information and with the segmentation of input representations prior to the assembly of articulatory instructions, as well as problems with the execution of speech motor programmes.

Gathercole et al. (1994) have however attempted to assure critics that NWR is a valid measure of phonological memory. In their discussion of the cognitive processes involved in phonological memory they argue that Nonword Repetition is significantly associated with digit span, that it is almost impossible to separate phonological analysis from memory, and that output constraints are unlikely to be significant in children over the age of five years. In dealing with children with SLI such confidence may be misplaced however, since these children can have persistent perceptual difficulties and problems with speech output.

In summary, the literature reviewed on the relationship between phonological memory and vocabulary development suggests that this may be an important area to investigate in relation to vocabulary deficits. It may be a particularly important area of enquiry if children with vocabulary deficits are found to have difficulty acquiring the phonological representations for unfamiliar words.

1.8 Summary and a way forward for studying word learning.

Research has suggested that a breakdown in the word learning process may account for vocabulary deficits in children with SLI. However as yet the extent, nature and source of this breakdown remains unclear. In particular we are left wondering whether children with SLI have impoverished/imprecise phonological or semantic representations or both.

With regard to the extent of the difficulty it is suggested that this can be clarified by more refined experimental methodology viz. by ensuring that the clinical group all have lexical deficits, by including age and language matched controls in the study and by offering different contexts for learning new words.

If we also wish to increase our understanding of the nature of the problems we need to systematically investigate what aspects of words children with SLI struggle to learn. One possible way to achieve this is by focused assessment of the child's lexical representation following exposure to new words.

Levelt (1989) suggests that each word in our lexicon has four types of information associated with it:

- a specification of the item's meaning
- a set of syntactic properties including the category of the item (e.g. verb), the syntactic arguments it can take e.g. that it is transitive, and other properties
- a morphological specification of the item e.g. for the word "eat", that it is a root form, that its third person present tense inflection is "eats" and that its past tense inflection is "ate"
- a form specification - in particular the item's composition in terms of phonology.

If assessment tasks are constructed to investigate learning of even the phonological and semantic components of the lexical representation, the resulting data might provide a starting point from which to launch further investigations into the underlying processing skills which support this learning.

With regard to the source of children's lexical deficits a number of explanations have been discussed. These included the effect of limited grammatical abilities on the acquisition of the meaning of unfamiliar words, and phonological processing and memory explanations for difficulty acquiring the phonological representation. However the source of children's vocabulary deficits may be best studied when the nature of their difficulties in word learning has been more clearly established.

In section 1.1. it was stated that the research described in this thesis will be carried out in two stages. It was suggested that this sequential approach would be an effective one in clarifying the areas above. Therefore in the first stage of the work the extent and nature of word learning difficulties in children with vocabulary difficulties will be explored. Supported by data which provides insight into the nature of the learning problems experienced, the second stage will focus its investigation of underlying processes more appropriately than in previous research.

CHAPTER 2 RATIONALE FOR AND APPROACH TO THE STUDY OF VOCABULARY DEFICITS IN CHILDREN WITH SLI

2. Introduction

The review of the literature (Chapter 1) established that vocabulary deficits are reasonably common in children with SLI yet remain poorly understood. In this chapter, firstly the rationale for addressing the lack of understanding in this area will be considered. Following this, the approach taken in this thesis to addressing the limitations in our knowledge will be described. The chapter will conclude with an overview of the thesis as a whole and will include the research questions which are addressed in the course of this research.

2.1 Rationale for further research into vocabulary deficits in children with SLI

In Chapter 1 the prevalence of vocabulary deficits in children with SLI was described. However the frequency with which they occur is not in itself the main reason to carry out research in this area. As will be seen in the following sections, the ongoing requirement for vocabulary acquisition into adulthood and beyond, the consequences of vocabulary problems for the child and the lack of knowledge on which to base intervention are important justifications for research in this area.

2.2 Vocabulary development: a sizeable and long-term requirement.

Effective spoken communication requires competence in a number of areas in addition to vocabulary. These include phonology, syntax, and morphology. In terms of size however vocabulary is the largest of these components. According to Aitcheson (1994) an educated adult can comprehend and potentially use at least 50,000 words and this is probably a conservative estimate.

Another important point when compared with other language components is the timescale over which children are exposed to new vocabulary, with the requirement to learn at least some new words persisting for many years. Unlike phonology, syntax and morphology, where the bulk of learning has taken place by the early school years, if not before, the development of vocabulary escalates between the ages of seven and sixteen years. During this time it is estimated that normally developing youngsters may be learning around 3,000 new words each year (Nagy and Herman, 1987).

And even though the rate of vocabulary growth often slows down in adulthood, depending on their educational and occupational experiences (Gathercole and Baddeley, 1993), some individuals will continue to learn new vocabulary for a large part of their adult life.

If as suggested in Chapter 1, children with SLI have problems learning new words, the scale and extended nature of vocabulary development will mean that there is little opportunity for them to catch up and as was also seen in Chapter 1, their problem may become more marked as they get older.

2.3 Consequences of vocabulary deficits.

For children with vocabulary deficits there may be negative educational and communicative consequences. Their general understanding of language will be compromised if they comprehend fewer words than their peers. When speaking or naming pictures they may produce fewer correct words or have difficulty in finding words. According to Wiig, Semel , & Nystrom (1982), in spontaneous speech children with WFDs are dysfluent. For example they may produce long pauses, semantically empty place-holders (e.g. 'uh'. 'uhm'), circumlocutions, stereotypic starters and perseverative repetitions. Faust et al. (1997) suggest that the disruption and imprecision in the children's speech can leave listeners confused and uncertain of the children's meaning in conversation. Furthermore these authors noted that frustration in children with word-finding deficits was very much in evidence in their research involving a picture naming task and suggested that this might have emotional repercussions.

In school, vocabulary deficits undermine a child's success with the curriculum. Wells (1986) found that the size of children's vocabulary was strongly associated with their school achievement. More specifically a poor receptive vocabulary will affect reading comprehension. Beck, Perfetti, & Mc Keown (1982) suggest that if too many words in a text are not understood, it may become very difficult to construct the overall meaning. If words are known, but their meanings less accessible, this may divert processing resources away from understanding the whole text and interfere with reading comprehension. This relationship is confirmed to some extent by their intervention study which improved reading comprehension by vocabulary instruction.

The repercussions of vocabulary deficits provide strong motivation for speech and language therapists and teachers to intervene. Successful remediation has been hampered however, by a lack of understanding about the nature of the difficulty, and consequently the best form of management.

2.4 The lack of knowledge on which to base intervention

One view of intervention for vocabulary deficits is that it should ideally be based on a sound understanding of the nature and source of the child's problem. Currently however, effective intervention is constrained both by the lack of such knowledge and the preoccupation in the literature with word-finding difficulties (WFD) to the exclusion of more general lexical deficits where both receptive and expressive vocabulary may be limited.

The preoccupation with WFD and the uncertainty about the nature of the problem is reflected in the styles of intervention reported in the literature. Since 1989 a small number of intervention studies for WFD have been reported (Casby, 1992; Easton, Sheach, & Easton, 1997; Hyde Wright, Gorrie, Haynes, & Shipman, 1993; Hyde-Wright, 1993; McGregor, 1994; McGregor & Leonard, 1989). In many of these, activities to improve both storage and retrieval of words are described. This suggests that researchers are not prepared to dismiss access difficulties as an explanation for WFD, despite the findings of Kail & Leonard (1986), and McGregor and Waxman (1998) who favoured limited storage, as opposed to retrieval difficulties as a cause of WFD. Intervention also often includes both phonological and semantic information for storage and retrieval but unfortunately findings do not agree as to which is most beneficial.

An alternative view is that remediation for vocabulary deficits need not be based on an explicit understanding of the nature and source of the problem. Instead words can be taught as part of a structured programme without reference to the nature of the problem or based on an assumption about the nature of the problem. For example (Crystal,1987) stresses the need for a "semantic curriculum" in which children with vocabulary deficits are provided with enhanced opportunities for learning new words through careful vocabulary selection, and definition. This approach may be limited however if children have problems learning the phonological form of new words and in addition the effectiveness of such an approach is likely to be constrained if we consider the scale of the vocabulary learning task.

Nagy and Herman (1987) suggest that to bring a low-vocabulary student up to the median would usually require them to learn 4000-5000 words or more, as well as the annual 3000 word vocabulary growth already quoted. These authors also consider that even a very ambitious programme of vocabulary instruction would be unable to teach more than a few hundred words a year. Not surprisingly they conclude that it is unlikely that the gap between low and average vocabulary levels can be closed through direct teaching.

Because of the lack of promise vocabulary instruction has for successful intervention, these authors suggest that the most effective approach would be if children's incidental vocabulary learning could be increased. This in turn leads us back to the need for a better understanding of how the process of vocabulary acquisition might be breaking down in the first place and is a sound argument for research in the area of word learning.

2.5 Rationale for the approach taken in this thesis.

The basic premise of this thesis is that developmental vocabulary deficits may be accounted for by some deficiency in the acquisition process. Consequently the best way to understand the nature of the difficulty and develop more appropriate remediation is by expanding and refining the study of the learning process in children with SLI who have vocabulary deficits. There are two main justifications for adopting this approach .

Firstly SLI is a developmental condition characterised by problems with acquisition of one or more components of language, including vocabulary. Thus the study of learning has common sense appeal, supported by some empirical research documenting word learning difficulties or deficiencies in the information stored about words. It therefore makes sense to provide opportunities for word learning and to assess what children have acquired about unfamiliar words following exposure to them. The description of word-learning (Gathercole, 1993) in Chapter 1, section 1.5 emphasises the importance of two main types of information to be acquired for any new word, the meaning and the phonological form. This in turn suggests that a focused study of the word learning process should attempt to clarify whether the acquisition of one or both types of information are problematic for children whose SLI includes a vocabulary deficit. Such a study has not yet been adequately carried out.

If it is possible to gain insight into the nature of the breakdown in children with SLI through a study of their word learning, this will indicate the research area for the second stage of the investigation. For example, if there are difficulties acquiring the phonological form, the processes which underlie the construction of a long term phonological representation e.g. phonological perception, segmentation and phonological memory need to be considered. If the acquisition of semantic information is problematic, the processes by which meanings are deduced and mapped onto word forms need to be studied. If both areas are found to be problematic, then a decision about which merits further study in the first instance must be made.

The second important justification for adopting an approach which emphasises acquisition has already been alluded to in section 2.4. That is, remediation should aim to improve children's capacity to learn for themselves instead of teaching them words missing from their vocabulary. Improving the child's own acquisition skills is more necessary for vocabulary than any other component of language. For example, it may be practical to teach children the relatively small number of phonological or grammatical rules that they have not acquired. However if a child is falling behind his peers in vocabulary development, teachers and therapists first need to establish what words are not learned or are learned inadequately (in itself a more difficult task than for either phonology or grammar). Then the words have to be taught. This will be particularly difficult if the child has large gaps in his vocabulary knowledge. The fact that demands for rapid and effective word learning continue for many years makes maintaining an appropriate level of vocabulary development unrealistic. If, however, deficits in the learning process can be identified and children helped to learn for themselves, the remediation of vocabulary deficits is likely to be more effective and far less time consuming.

2.6 Overview of the thesis

This thesis presents two sequentially related studies which aim firstly to clarify the nature of word learning deficits and then to investigate underlying cognitive processing relevant to vocabulary acquisition. Because of the dearth of studies in this area, an important part of the thesis is devoted to developing an appropriate method for studying word learning in a group of children with SLI. The opportunities for learning, the assessment of what children learn when confronted with new words and tests of processing skills are given considerable attention.

In Chapter 1, the literature relevant to the study of lexical deficits was described. After some explanation of the terminology used in the thesis, previous studies of word-learning in children with SLI were reviewed because these have inspired and directed the current area of investigation. A critical analysis of these studies revealed methodological shortcomings which resulted in some lack of consensus about whether children with vocabulary deficits had problems with word learning. This in turn identified the need for an expanded and refined study of word learning to include different contexts for word learning, initial and further exposure to unfamiliar words, and comparison between children with SLI and both language-age matched and chronological age-matched controls.

Following the review of word learning studies, the literature pertinent to the nature of the problem and the processing on which lexical development may depend was reviewed. From this it became apparent that it is unclear whether children have problems learning the phonological or semantic information for new words or whether they have difficulty with both. This in turn suggested the need for careful consideration of the way in which word learning is assessed so that the nature of the problem can become more transparent.

Finally the chapter reviewed a body of literature which considers what underlying cognitive processing deficits might contribute to vocabulary deficits. To date this has mainly focused on the phonological processing and memory skills which might underlie the acquisition of phonological representations. Furthermore the extent to which these areas have been explored in children with lexical difficulties is mainly limited to single case studies.

This chapter (Chapter 2) has mainly addressed the rationale for, and the approach to, the study of lexical deficits. With regard to the latter, a principal standpoint is that vocabulary deficits might be best understood if the nature of vocabulary deficits is explored by assessing what children have learned about new words presented in controlled but natural contexts and if the subsequent investigation of underlying processing is guided by what is discovered about the nature of the problem.

Chapter 3 describes the development of an experimental paradigm to study word learning. The theoretical considerations which guided the final choice of words, contexts and assessment materials are described. In addition a pilot study which allowed these to be tried out and refined is included.

The study of word learning reported in this thesis (Study 2) was carried out in two contexts, a Story context and an Explicit Teaching context. In each of these, one set of four unfamiliar nouns was introduced. Chapter 4 describes Study 1. This explored whether two groups of pre-school children with normal language development found these two sets of words equally easy to learn when they were presented to the children in the same way. Results indicated this was the case and consequently it was possible in the next study, Study 2 to evaluate the influence of context on word learning.

In Chapter 5 the main research questions addressed in Study 2 are stated. These asked:

- Do children with SLI have problems with word learning and if so, how much poorer are they than their peers?
- What is the nature of word learning difficulties in children with SLI ? Do they have problems with learning phonological information, with acquiring the meanings of new words or with both?

Following this, the experimental method used to address these questions is described in detail. The particular issues of subject selection and matching are considered. It will be seen that the experimental method described pays particular attention to selecting participants with vocabulary deficits in the SLI group and to identifying their matched controls. This, together with the careful design of the word learning paradigms and the assessments of word learning, makes Study 2 more comprehensive and rigorous than previous work in this area.

The results from Study 2 and the discussion of these form the bulk of Chapter 6. These include comparisons between the SLI and control groups with respect to total word-learning, assessments of phonological and semantic learning, the effect of additional exposure, the effect of context and word length, and an analysis of learning effects for individual words. As anticipated, the study of word learning provided evidence regarding the nature of children's word learning problems. The children with vocabulary deficits appeared to have problems learning both the phonological and semantic information for the experimental words but there was a suggestion that phonological learning was more problematic. This in turn was the basis for a focused enquiry addressing the source of the difficulty children apparently had with phonological learning.

Chapter 7 describes the second main stage of the investigation. In view of the results of Study 2 which identified a possibly greater problem with phonological learning, Study 3 investigated phonological learning, processing and memory in the same group with SLI as in Study 2. The following research questions were addressed:

- Do children with SLI have problems acquiring and retaining new phonological forms?
- Do children with SLI have problems linking two pieces of lexical information (in Study 3, a proper noun and a common noun) and retaining these links?
- Do children with SLI have phonological processing and memory problems?
- Is the acquisition of new phonological forms related to phonological processing and memory abilities?

Chapter 8 discusses the overall implications of the results and explores directions for future research.

CHAPTER 3 EXPANDING AND REFINING THE STUDY OF WORD LEARNING IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT

3. Introduction

This chapter describes the development of an experimental paradigm to study word learning. This paradigm was developed to include two contexts in which children are exposed to new words, a pre-test and five assessments of word learning. In the first part of the chapter, the considerations which guided the devising or choice of experimental materials and tasks are described. The way in which the chosen experimental paradigm attempts to address some of the shortcomings of previous research into vocabulary deficits and word learning in children with SLI is also highlighted.

In the second part of the chapter a pilot study is described. The main purpose of this was to highlight any difficulties in either the content or administration of the experimental procedure, by carrying it out with predominantly pre-school children.

In the course of the pilot study it became clear that some modifications to the experimental paradigm were necessary. These are described in the final part of the chapter.

3.1 Refining and expanding the study of word learning

A major aim of this thesis is to provide insights of clinical and therapeutic value for children whose SLI includes lexical deficits. Consequently the techniques used in previous research in this area must be refined and expanded to illuminate the <u>nature of the difficulties</u> in vocabulary acquisition for children with SLI. A basic premise of such research as stated previously is that the lexical difficulties experienced by children with SLI are rooted in faulty or inadequate learning of new vocabulary. This notion, apart from its common sense appeal, is supported by both some empirical evidence and clinical observation in children with SLI (Constable, Stackhouse, & Wells, 1997;

Kail & Leonard, 1986) and those with dyslexia (Snowling, van Wagtendonk, & Stafford, 1988).

If the study of word learning provides a useful standpoint from which to understand lexical deficits, careful attention needs to be given to the design of such research. This is necessary so that insights can be generalised to vocabulary acquisition in children with SLI in the real world. This means that the items to be learned and word learning opportunities should be reasonably natural and representative. Furthermore, assessments should provide relevant information about the nature of the child's learning difficulty.

The main considerations in designing word learning experiments are as follows:

- the choice of the new words to be taught and the information provided about them
- the number of new words introduced and the amount of exposure given to them
- the contexts provided for learning
- the choice and design of tasks for assessing word learning.

These will be considered in the sections which follow.

3.1.1 The type of new words

In any study of word learning a decision has to be made about the type of words to teach because words vary in a number of ways. These include:

- the unfamiliarity of the word
- the word's grammatical function and complexity e.g. whether a noun or a verb
- the length and phonological composition of the word.

In a particular study, words may be chosen to address a specific research question or to minimise possible confounding variables. For example Schwartz (1988) was interested (among other things) in the acquisition of transitive versus intransitive verbs in pre-school children with normal and impaired language development. The choice of verbs included in the study was therefore governed by whether or not these could take an object. However Schwartz also controlled the phonological complexity of the words by constructing nonwords compatible with the children's level of pronunciation. Furthermore the use of nonwords ensured their unfamiliarity. In a study by Gathercole & Baddeley (1990) designed to investigate the role of phonological memory in word learning, choice of word length was carefully considered. Two groups of children were taught 2-syllable words and nonwords. This word length was chosen because both groups performed best on nonword repetition of 2-syllable words. By choosing a word length which both groups of children could repeat, the authors eliminated difficulties encoding or producing the words as reasons for any differences between the groups in acquisition.

Some studies have considered some aspects of the words taught but not others. In a study by Michas & Henry (1994) which looked at word learning in relation to phonological memory, the authors took steps to establish that the words were unfamiliar but did not ensure that all the children were taught words with the same number of syllables. For example <u>tapir</u>, a 2-syllable word, was taught to some children as an alternative to the 3-syllable word <u>platypus</u>. In the studies by Rice, Buhr, & Oetting (1992), Rice, Buhr, & Nemeth (1990), and Rice, Oetting, Marquis, Bode, & Pae (1994) words appear to have been selected on the basis of unfamiliarity and to provide a variety of word classes such as verbs, nouns, words denoting attributes etc. However although a variety of word lengths was often included, this appears to occur more by default than as the result of a conscious decision.

3.1.1.1 The type of words to be used in this thesis

Because vocabulary acquisition is being studied, the words included in the learning paradigms should be unfamiliar to the children. Published tables including ratings of age-of-acquisition and familiarity for 1,944 words (Gilhooly & Logie, 1980) were consulted to select words likely to be unfamiliar to the age groups included. The words were chosen as words infrequently used and to have a high age of acquisition rating (see below). To ensure that the words were unfamiliar children were pre-tested for their knowledge of the words before the learning trials (see section 3.1.5.1).

In this thesis, nouns were selected for the word learning experiments. Some research studies however have looked at the acquisition of a variety of word classes such as verbs, attributes and affective states (Oetting, Rice, & Swank, 1995; Rice et al., 1992; Rice et al., 1990; Rice et al., 1994). The use of nouns therefore has limitations because results cannot be generalised to other types of words. However by choosing nouns it was possible to draw more obvious pictures and to achieve consistency in the type of information given about each word's meaning.

Words of one, two and three syllables were used in the word learning experiments. This simulated the demands of vocabulary acquisition in the real world where a variety of word lengths is encountered.

Final criteria for words chosen were as follows:

- The words had to have an age of acquisition rating in advance of the expected vocabulary ages of the children to be studied. Thus, on a scale of 1 (0-2 years) to 7 (age 13 years and older) all words chosen had a rating greater than 5 (age of acquisition above 8 years 7 months).
- They had to be infrequently used. This was determined using the familiarity measure which rates words on a scale of 1-7 where a rating of 1 is equivalent to "never seen heard or used" and a rating of 7 is equivalent to "seen, heard or used every day." All words chosen had a rating of less than 3.14 and therefore could be considered to be used infrequently. In addition their occurrence in adult speech to 5-year old children was determined from the work of Hall, Nagy, & Linn (1984) and found to be either non-existent or extremely low.

- Nouns were selected for the study. Individual items were chosen if they fulfilled the other criteria listed and lent themselves to inclusion either in a story devised to appeal to young children or in a context where they could be explicitly taught.
- They could be defined by giving an attribute and the category to which that word belongs. These aspects of meaning were chosen from definitions in the Collins English Dictionary (1993) as being fairly central and easy to depict or explain.
- They were easy to represent in pictures.
- A variety of word lengths, 1, 2, and 3 syllable words were included.
- Children of 5-6 years with normal speech development should have no difficulty pronouncing the words.

The words initially chosen which fulfilled these criteria were *phial, polka, aster, molasses, jade, brigand, gauntlet* and *albatross*.

3.1.2 Number of words and frequency of exposure

Studies of word learning in the literature have varied in the number of unfamiliar words introduced per context and the number of exposures given to them. Dollaghan (1985, 1987) in her studies of "fast mapping" introduced only one unfamiliar word, "*koob*", once before assessing comprehension, and twice before assessing production. Robbins & Ehri (1994) introduced 11 new words in a story, some heard four times, others twice. Rice et al. (1994) introduced eight new words in a story and measured children's comprehension following 3 and 10 exposures compared with a control situation in which none of the new words were heard. In yet other studies (Rice et al., 1990; Rice & Woodsmall, 1988), 20 words were introduced over two video sessions with, in the main, 10 repetitions. In research by Gathercole & Baddeley (1990), children were introduced to four real and four nonword names in two separate learning sessions. Each set of words was repeated until the children could correctly name the toys or until the children had a maximum of 15 exposures to the new words. The results from some of these studies have already been described in Chapter 1.

The choice of an appropriate number of words and the amount of exposure to them is important if realistic demands are to be made on the children's learning, and if floor and ceiling effects are to be reduced or avoided. This is particularly important when control and experimental groups vary greatly in age. Too many words and too little exposure may mean many children fail to score thus obscuring group differences. The converse may apply with too few words and too much exposure.

In selecting an appropriate number of words and frequency of exposure, previous studies of word learning provided helpful indications. For example, both children with normal language development and those with SLI were able to comprehend new words even when exposed to as many as eight, provided there was sufficient repetition (Rice et al., 1994). Robbins & Ehri (1994) suggested that four repetitions were required but not necessarily sufficient in a story context to ensure comprehension of a word's meaning in normal children. Rice et al. (1994) found that after three exposures, 5-year old normal children, but not 5-year old SLI children or their 3-year old MLU controls, made some gains in vocabulary knowledge. They also demonstrated based on previous work (Rice et al., 1992) that normal 3-year olds understood new words with as few as six exposures (three times each in two viewings). Children's production of words however is usually poorer than their comprehension (Dollaghan, 1985; Heibeck & Markman, 1987; Michas & Henry, 1994) and to achieve success on naming tasks children may require more repetition.

The above results guided the choice and number of words used in Studies 1 and 2. It was decided to include four new words in each of two contexts, each repeated five times. Because the learning trials occurred on two consecutive days, the number of repetitions was doubled by the end of the second learning trial. In each context one 1-syllable, two 2-syllable and one 3-syllable words were introduced.

The details of the words used in this thesis, including their age of acquisition, familiarity ratings, frequency of occurrence in adult speech to children and the aspects of meaning highlighted in the learning contexts are displayed in Appendix 1

3.1.3 The choice of contexts

Children learn new words in different contexts and the ease with which they learn may be affected by the extent to which attention is drawn to the words and also the extent to which their meanings are made explicit. Robbins & Ehri (1994) cite Werner and Kaplan (1950) who described two main contexts in which new word meanings are learned.

One of these is where children hear words incidentally on television, in stories and in conversations. The demands for inducing meaning in such contexts are greater since the word meaning may not be expressed or obvious and children must therefore use context and other information to discern meanings.

The other is where adults directly and explicitly name objects or define words for children. This may be more similar to occasions in school where the child is introduced to a number of new words and their meanings. According to Robbins & Ehri (1994), using evidence from the literature, children can effectively use both direct and indirect references to learn new words by the time they enter elementary school.

To understand the nature of word learning in children with normal and abnormal language development it is therefore desirable to explore their acquisition of new words in different contexts. This gives a clearer picture of their word learning capacity overall and may also allow comparison between contexts. The latter may provide insights about the factors contributing to poor lexical development.

Recent studies have sampled word learning in a variety of contexts including specially adapted videos (Rice et al., 1990; Rice & Woodsmall, 1988), stories (Robbins and Ehri, 1994) and situations where words are more explicitly taught (Michas & Henry, 1994). However there appears to be no study currently published which compares children with SLI and those with normal language development in more than one context in the same study.

For this reason it was decided to study two contrasting contexts for word learning: an Explicit Teaching context where pictures are explicitly named and described and a Story context where word meaning has to be deduced from the pictorial and linguistic context.

3.1.3.1 The Explicit Teaching context

This method of presenting the words has some similarities to that described by Michas & Henry (1994) in their "instruction paradigm". These researchers introduced the words by presenting the child with a colour picture of each item and underneath, two other pictures relevant to the word. The child was asked to repeat the word after the experimenter, and told three aspects of the word's definition which he was asked to remember. For example for *'platypus'*, the children were told that it had a flat nose, liked to swim and eats worms.

In the research for this thesis, the new words were introduced using a coloured picture of each item clearly depicting the relevant semantic information accompanied by a set verbal description. The description referred to specific aspects of meaning i.e. the category to which the item belongs (e.g. bird) and an attribute of the item (e.g. big).

3.1.3.2 The Story context

The story was written to take account of factors considered important in helping children attend to the text (Elley, 1989), and included attractive characters with whom children could identify and some humour. It provided a contrasting context for the introduction of new vocabulary because the information about the meaning of the unfamiliar words was much less obvious than in the Explicit Teaching context. The category to which the word belonged and an attribute which could be used to define it however could be derived from the linguistic and pictorial information in the story.

3.1.4 Choice and design of tasks for assessing word learning.

Assessments included the Pre-test to the establish that the phonology and meaning of the experimental words were unfamiliar and initially four assessments of word learning.

In this research it was considered very important to devise assessments of word-learning which were more specific than in most previous research and which differentiated between the aspects of the word which had been learned.

In Chapter 1 section 1.8 it was suggested that assessment might be guided by the information which Levelt (1989) suggests is stored in a lexical entry, i.e. the word's meaning, syntactic and morphological properties as well as a specification of its phonological form.

Taking this into account, one can select the information to be assessed in any measure of word learning. In this thesis an important aim was to attempt to disentangle semantic and phonological knowledge about words in assessment because this might offer insights into what the child is having difficulty learning. This has already been attempted to a limited extent in some studies. Authors such as Dollaghan (1987), Gathercole (1993), and Haynes (1982) have suggested that the word learning difficulties in children with SLI are primarily phonological. However, often rather limited exploration of the child's semantic knowledge for the same words may mean that difficulties learning the meaning have been overlooked. Because it is equally possible that children with SLI have problems with deducing or retaining the meaning of new words such deficiencies in word learning measures need to be addressed .

When devising assessments of word learning it is extremely difficult to separate semantic from phonological learning. Most tasks defy attempts to exclude one or other type of information completely. This point becomes clearer if models of single word processing for recognition and production of single words are applied to the analysis of the assessment tasks.

Chiat (1993), describing a model of processing appropriate for children adapted from the work of Morton and Patterson (1980), Levelt (1992) and Butterworth (1992), states how in understanding a word the child must "discriminate auditory input; decode this input into relevant phonological units; match decoded phonological units to a stored phonological representation and access the corresponding semantic representation" (p.201). Thus standard tasks such as selecting a picture when a word is named rely first on phonological information before accessing any stored semantic information in order to match meaning to the correct picture. Similarly any other attempts to access semantic knowledge such as asking a child to define a word or answer questions about a word will first rely on the child having enough phonological information stored to recognise the word.

Both semantic and phonological information are also necessary in word production. When asked to name an object or a picture, word production is driven by the semantic representation to access the corresponding phonological representation which is then encoded phonologically and finally articulated. Even tasks such as recognition of a word's correct pronunciation when a picture is present may involve semantic information to access the stored phonological representation.

An alternative way of considering assessments of word learning which still allows some distinction to be made between phonological and semantic learning is to classify tasks according to the information sought for scoring purposes. Thus a naming task seeks phonological information and a picture selection task scores for semantic information. A further aid to differentiating between tasks takes account of how complete the information needs to be in order to achieve a full score. For example a child may be able to correctly identify a picture named (displaying semantic knowledge) with partial phonological information as long as this is sufficiently distinct from other words stored (Bishop, 1997).

On this basis it is possible to categorise the assessments according to emphasis, i.e. those which emphasise semantic knowledge and those which emphasise phonological information.

Some other aspects of task design also deserve consideration. These include the links between phonology and semantics, the effect of other task demands, and the effect of chance on a child's success.

The links between phonology and semantics.

Models of both word production and word recognition emphasise interactions between phonology and semantics. In order to produce or understand a word correctly, the links between these pieces of information need to be established at some point in the learning process. If these links between sound and meaning are weak or incorrect then errors may occur even though the representations themselves may be correct.

The effect of other task demands and chance

Various complicating factors may affect a child's score and thus the measures may not accurately reflect the status of the child's learning. These include success by chance and other demands inherent in the tasks.

Depending on the assessment format, children may attain a score by chance. Tasks which involve selecting from alternatives are an obvious example, with the level of chance dependent on the number of alternatives. In contrast, when a child is required to produce a response in the absence of alternatives, the effect of chance is more indeterminate.

Secondly other demands may be inherent in the tasks and may cause a child to fail despite having learned the requisite phonological or semantic information. For example when asked to name a picture, the child may have a fully specified phonological representation yet be unable to realise this because of motor speech demands or because of a transient difficulty with retrieval. Other confounding variables may include metalinguistic and memory demands in a task. For example a child asked to choose from a series of alternatives must have the requisite span to hold these in memory until the task is performed.

These two sets of complicating factors, i.e. chance and other demands, may result in two possible scenarios. Firstly, it is possible for a child to achieve success on a particular measure even when the requisite learning has not taken place. Conversely, a child may have learned the aspects of meaning and pronunciation tested yet be unable to demonstrate these because of demands inherent in the tasks which he cannot meet appropriately. In devising the tasks these considerations were borne in mind.

An analysis of the learning and other demands of the assessment tasks used in this thesis is included as Appendix 2.

3.1.5 The Pre-test and the assessments of word learning

3.1.5.1 The Pre-test

Researchers who use real words in word learning experiments usually carry out a pre-test to assess the level of children's familiarity with the experimental words. Two types of task have been used for this purpose. For example Michas and Henry (1994) asked children to name pictures of the experimental words and Rice and her colleagues, (Oetting, Rice, & Swank, 1995; Rice, 1990; Rice, Buhr, & Oetting, 1992; Rice, Oetting, Marquis, Bode, & Pae, 1994) used a picture comprehension task to assess knowledge of the experimental words prior to the word learning experiments. These pre-tests may not satisfactorily establish the extent of a child's knowledge about the experimental words however. In *naming* children may have some knowledge of the word but have difficulty retrieving it because it is not very well known. In *picture comprehension*, children may fail to choose correctly but could for example be familiar with the pronunciation but not the meaning of the experimental words. A more stringent Pre-test was therefore devised in which children were asked if they had heard the words before. This assessed whether children were familiar with the words' pronunciation even if they did not know the meaning. Children were also asked about the meanings of the words. The Pre-test included very familiar words, less familiar words, nonwords taken from Gathercole et al. (1991), and the experimental words.

There were two versions of the Pre-test, one for the Story context words and one for the Explicit Teaching context words.

3.1.5.2 The Naming Test

The child is asked to name pictures of the experimental words one by one. This test differentially emphasises phonological learning since the information elicited is phonological and to obtain a full score the child must have a full phonological representation.

3.1.5.3 The Word Recognition Test

In this task the child is asked to select the correct pronunciation of the word from a choice of four. To do so the children are required to recognise the correct phonological form of the word, presumably by comparing it with their existing phonological representation for that word. However only two phonemes (the nuclear vowel and the consonant following it) need be stored in the child's phonological representation in order to achieve a full score. For example in the word '*polka*' the child could choose the correct form provided he had stored the /o/ and the /l / enabling him to reject /poŋka/, /piŋka/ and /pilka/. This task therefore also differentially emphasises phonological learning but unlike naming will not be affected by speech output difficulties.

3.1.5.3.1 The construction of a Word Recognition test

The construction of the Word Recognition assessment required particular attention. Therefore the theoretical considerations which guided its construction will be described at this point.

It was devised and included as a measure of word learning for two main reasons:-

- Firstly, it was anticipated that some of the children would be unable to name most of the new words after the first or even second learning opportunity. This might occur because children have no information at all stored about the sound of most of the new words given the amount of exposure in the learning opportunities. Alternatively, children may have stored partial information but this may be insufficient to allow them to provide a name. Yet other children may have a full phonological form stored for the new word which they are unable to retrieve. These possibilities meant that the naming test might not differentiate between children who had no information stored about the sound of the new word and those whose information was incomplete.

- A second reason for including the Word Recognition test is because some children with SLI have difficulties with pronunciation. As a result their naming responses might not reflect the phonological information they have stored because of motor speech problems. Consequently if one wishes to compare phonological aspects of word learning between groups of children, it is necessary to include a measure of phonological learning which enables differences between the groups not apparent on the Naming test to emerge. The Word Recognition test attempts to assess whether the child has stored partial phonological information about the new words by asking the child to recognise the correct pronunciation of the word from a choice of four.

The construction of the Word Recognition test is based on the assumption that we are somehow able to assess the child's phonological representation for the experimental words in the absence of production.

Assessments of this type have been carried out by a number of researchers (Constable et al., 1997; Dollaghan, 1987; Gilbertson & Kamhi, 1995; Haynes, 1982). When children are unable to name a novel item correctly they are asked to select the accurate form from a range of words varying in phonological similarity. Devising an assessment which tries to access a child's phonological learning in the absence of production is problematic and many previous attempts have been crude and lacking an explicit theoretical basis for the choice of distracter items. If we accept Meyer's (1990) statement that the phonological representation of a word "is usually taken to include a description of the word as a sequence of phonological segments and a description of its syllabic structure" (p.524), it is obvious that establishing whether a phonological representation is complete, particularly for longer words, is impossible without quite extensive testing.

In devising a test of acceptable length for young children, decisions have to be made about which phonological segments to probe in assessment. Some information useful for planning such an assessment comes from research by Aitcheson (1972), Aitcheson & Chiat (1981), Echols (1993), and Vihmann, (1981). These researchers have looked at which segments of words have been accurately preserved in children's erroneous attempts at a word and they inferred from this information which parts of words may be more salient for storage. The difficulty with this research is that conclusions are drawn from different data sources including children's malapropisms collected in response to a newspaper request (Aitcheson, 1972), young children's early words (Echols, 1993), children's lexical errors drawn from a wide variety of sources and older children's errors when learning new vocabulary (Aitcheson & Chiat, 1981). Furthermore the information reported sometimes relates to individual words and at other times to the whole corpus of data. Consequently in comparing segments of words across studies there is not always agreement about how well they are retained. An added complication is that salience of particular segments may vary with age and the extent to which children have been exposed to the printed word.

One part of the word which seems to have relatively greater salience however is the stressed syllable and its surrounding consonants. Echols and Newport (1992) referred to work by Frumhoff et al. (1992) who found that 4-year olds were more likely to imitate a stressed syllable accurately than an unstressed syllable. Aitcheson (1972) found that the nuclear vowel (i.e. the vowel in the syllable with primary word accent) was identical in 78% of children's malapropisms and was the second most salient feature after the word's accentual pattern. As already stated however, even here variation is found. For example although the nuclear vowel was the second most salient phonological property of a word (after accentual pattern) in the data of Aitcheson (1972) and Vihmann (1980), in the Aitcheson and Chiat (1981) study referred to above, the stressed vowel /u/ was poorly retained in two of the unfamiliar words. Similarly, although the consonants preceding and following the stressed vowel were generally well preserved, there seemed to be some slight advantage for the consonant following, rather than preceding the nuclear vowel (Aitcheson; 1972, Vihmann; 1980). Furthermore if the consonant preceded a stressed syllable in word initial position it was somewhat unstable where it did not agree in voicing with the consonant following the stressed vowel.

On the other hand, unstressed syllables seem to lack salience. Echols (1993) found that in young children's productions unstressed syllables were less likely to include accurate segments of phonetic information and were more inclined to be reduplicated or realised as filler syllables.

Although information about perceptual saliency is to some extent equivocal, the saliency of the stressed syllable has been used as a basis in the construction of the Word Recognition test. By altering these more salient segments in a multiple choice recognition task, the child can be given the opportunity to choose the correct form of the word from a range of alternatives. If successful the child may be said to have stored at least these more salient phonological segments.

The information gained from the research studies above is reflected in only one study (Haynes, 1982) which assessed word learning. In it Haynes used a recognition task to assess phonological learning in children with SLI and normal language development. Each target word was presented alongside three distracters which varied in the degree to which they were similar to it. Although not explicitly stated, an awareness of perceptually salient phonological features seems to have guided the construction of these distracter items to some extent. In Haynes'(1982) test, because she wished to differentiate between degrees of phonological learning, the distracters varied in the degree of phonological similarity to the target words. However nonword distracters in the same grouping were not always equally dissimilar and the construction of these could have benefited from more rigour.

As already stated, the aim of the Word Recognition assessment is to differentiate between children with SLI and children with normal development with regard to the accuracy of their phonological representations. The children will therefore be required to select the correct phonological form of the word from a range of four items. The three distracters will be constructed by manipulating those features which seem, from available research, to be among those more salient for storage. Taking the above research into account, segments in the words' phonological form which were manipulated were the nuclear vowel and the consonant following it. Including the correct form there were four choices for each word. Two were close distracters, one in which the nuclear vowel was altered and the other in which the consonant following the nuclear vowel was altered. There was one distant distracter in which both of these segments were altered.

3.1.5.4 The Meaning Recognition Test

This test differentially emphasises semantic information since the children are asked to respond to a series of yes/no questions about the words' meanings. Like word recognition children can score correctly on this task by chance.

3.1.5.5 The Picture Comprehension Test

In this test children are asked to select a picture of the experimental word when it is named. This test also differentially emphasises semantic learning because the child must access the semantic representation to respond correctly. Again a correct score can be achieved by chance.

3.2 The Pilot Study

The main purpose of the pilot study was to try out and refine the contexts and assessment materials which would be used to study word learning. This was necessary because in comparison with previous studies, a wider variety of learning opportunities and new assessment materials had been devised for this thesis. Because the pilot study would be the main opportunity to refine techniques, there was a degree of trial and error in working with the experimental materials. For example changes to the length and content of the story were made and tried out in the course of the pilot study. While this was helpful in refining materials and in seeing how any changes worked, it precluded any meaningful analysis of the data.

In any event the pilot study was not intended to address a particular research question.

3.2.1 Participants

Eighteen children were involved in piloting the experimental materials. Sixteen of these attended a university departmental nursery. The mean age of these children was 47.8 months (range 41-55 months.) Two older school age children were also included, mean age 74.5 months (range 65-84 months). Two of the pre-school children were excluded from the pilot following the pre-test because of poor co-operation or unreliable responses.

3.2.2 Experimental materials and procedure

Although both contexts were piloted, children only participated in one or other. The Story was piloted with a greater number of children (n=13) than the Explicit Teaching context (n=3) because refinements were made to the Story in the course of the pilot study.

On the first day the child was given the pre-test to ensure that the words were unfamiliar. The next day the child heard the new words in either the Story or the

Explicit Teaching context. Following the learning opportunity the child was assessed on the measures of word learning.

The Pre-test

There were two versions of the short pre-test for each set of words. The versions only differed in the order of words. At the start of the pre-test children were given the following instruction.

"I'm going to say some words to you. Some of them will be words you've heard people saying before like " bus", " dog", "house". Some of the words you won't have heard before like " naddlebow" or "pythagerous". I want you to say "yes" to the ones you've heard before and "no" to the ones you haven't heard before."

A short practice was followed by the test. Each test contained 16 words, viz. the four experimental words, four non words, four words with an early age of acquisition ratings and four with later acquisition ratings though not as late as the experimental words. As for the experimental words, ratings for age of acquisition were taken from the tables by Gilhooly & Logie (1980). Test forms for both sets of words are included as Appendix 3.

Following the pre-test, children were presented with one of the following two contexts.

The Story

In the Story the new words *phial, polka, aster* and *molasses* were presented. The words occurred five times. A humorous story about a mum who was ill (with spots) and whose children tried a number of ploys to make her better was the context for the four story words. It was accompanied by 14 coloured pictures depicting each word from the story twice.

During the pilot study the story evolved to become one in which the demands for inferring meaning increased to make it a better contrast to the Explicit Teaching context in which the words' meanings were explicitly defined. Because of the increased demands to deduce meaning the number of repetitions of the experimental words was increased to six times with some children during the pilot.

The Explicit Teaching context

In the Explicit Teaching context the words *jade, brigand, gauntlet* and *albatross* were introduced. Four coloured pictures, one of each new word were presented in random order in a game in which the experimenter and child took turns to hide the pictures. Each picture was accompanied by a simple definition which provided its category and also gave an attribute e.g. "This is a gauntlet. It's a long glove" when the pictures were initially presented, in the course of the hiding game and when they were put away. This format allowed each of the four new words and their definitions to occur five times.

Assessments

In the **Naming test** children were shown individual pictures of the four new items in random order and asked *"What do you call this?"* Answers were transcribed live and also tape recorded to check the accuracy of transcription. Responses were scored as follows: Two points were awarded for a correct form or a pronunciation in which there were minor phonetic variations of a segment or segments e.g. forward production of /s/, allophones of /l/ in '*polka*'. One point was awarded where 50% or more of the sounds from the target word were present and in the correct order in the child's form. A word scored zero when less than 50% of the sounds from it were present and in the correct sequence. Thus the child's responses were scored according to the amount of correct phonological information produced. The format of the Naming test appears in Appendix 4. Two words are different however because of changes following the Pilot study (see Section 3.3.1)

In the **Word Recognition test** the child was a grid with horizontal lines of four boxes and some coloured stickers. The researcher had seven pictures, three for the practice items and one for each experimental word. The visual props provided by the grid and stickers helped to counteract the possibility that other task demands such as short term auditory memory might affect the child's performance. This presentation was adapted from the work of Haynes (1982).

The task began with a practice session using highly familiar words. The researcher told the child the following :

"Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but one time I'll say the name just right. You've to put a sticker in one of the boxes for the time I said it just right. Let's practise first".

For the practice items the researcher showed the child a picture of a familiar object and said the word in four different ways. As each word was spoken the tester pointed to the corresponding box on the line of four on the grid. When the child had placed the sticker on the grid for each of the practice words, another similar grid and more stickers were given to the child. The experimenter then showed the child a picture of one of the experimental words and said :

"Now we'll do the same with these ones. Find the time I said the name of the picture just right. Is it....?"

Each experimental word and its three distracters were presented and the child was again required to choose the box on the grid corresponding to the time the word was said correctly. At all times the child was encouraged to have the sticker ready to avoid mistakes due to distraction caused by difficulty removing the sticker from its backing paper. Scoring was two for the correct form, one for either of the two close distracters and zero for the distant distracter.

The Test forms for the Word Recognition test used in the Pilot Study and in Study 1 are included in Appendix 5.

In the **Meaning Recognition Test** there were 16 yes/no questions about each set of four words from the Story or Explicit Teaching contexts. These were preceded by four practice questions about familiar words. There were four questions for each word, two relating to the attribute e.g. *Is a gauntlet long? Is a gauntlet short?,* and two relating to the category e.g. *Is a gauntlet a glove? Is a gauntlet a sock?* Both questions in a pair had to be answered correctly to score one point. Therefore a total of two points was available for each word if the child answered all four questions about it correctly. The method of scoring adopted for this assessment reduces the possibility of scoring a point by chance from 50% to 25%.

Questions occurred in random order but two questions about the same word did not occur in succession because a child's previous answer about a word might influence his next response. There were two versions of each test which varied in the random order of questions for each word set, and these were counterbalanced across the Time 1 and Time 2 learning opportunities (see tables 5.5-5.6).

Children were instructed as follows:

"Now I am going to ask you some questions and I want you to tell me if the answer is 'yes' or 'no'. Let's have a practice first."

Examples of the test forms are included as Appendix 6.

In the **Picture Comprehension** test children had to choose a picture of each experimental word from a choice of six coloured pictures when the word was named by the researcher. The set of pictures including each experimental item was mounted on a sheet of card and slotted into a polythene folder with clear plastic sheets. The position of the target items on each page was randomly determined. The order of presentation of the pages was also random. There were two random versions of the test with a form for each. The order of sheets in the folder was altered to correspond to the version of the form being used.

There were five distracters per item. To try and establish as far as possible that a child making a successful response had learned both aspects of meaning conveyed in the exposure tasks, two semantic distracters were included. Each of these shared one aspect of meaning with the taught word. For example for the phial (a small bottle) the semantic distracters included a **small** box and a big **bottle.** Thus if children had only grasped the meaning **small** they might equally choose the box. If they only remembered that a phial is a **bottle** on the other hand, they might choose the big bottle.

A further two distracters were considered neutral but were included to increase the number of items per page. These items did not occur in the learning situation and their meanings were much less close to the meanings of the target item than the semantic distracters.

The final distracter (the "mapping" distracter) was another item from the learning context. This was included because it is possible the child might have learned word meanings from the story but associated these with the wrong phonological forms.

Children were shown each item on each page and told the two aspects of meaning for each picture. This was to avoid difficulty in interpreting any of the distracter pictures e.g. the picture of a slow dance, the picture of a yellow food (custard). In addition it was hoped that this presentation would draw the contrasts depicted by the distracters to the child's attention. An example of the presentation for one item is as follows:

"Look at this page. Here's some food. Look it's yellow, here's a bottle, look it's big here's a box, see it's small etc. Now which one is called a phial ?"

A total of eight points was possible for each comprehension test - two points for a correct response or one point for choosing a semantic distracter i.e. with one aspect of meaning correct.

The test form is included as Appendix 7.

3.3 Modifications to the procedure following the pilot study.

Following the pilot study some changes were made to both the learning contexts and the assessment materials.

The Pre-test

Following the pilot study, criteria for the pre-test were established. A child would be excluded from the experimental learning opportunity if they did any of the following on the pre-test:

- Accepted more than one nonword without relating this to a known word similar in sound.
- Accepted any new word without relating this to a known word similar in sound.
- Rejected a new word but indicated knowledge of its meaning.
- Rejected more than one familiar word.

3.3.1 Learning contexts and words

Words

Two words, *brigand* and *jade* were removed from the Explicit Teaching context because it became apparent that *Jade* was quite a popular girl's name among pre-school children and *brigand* appears in a popular children's music tape. The words *kale* and *mica* were selected from the data produced by Gilhooly and Logie (1980) as infrequently used and likely to be unfamiliar. These were substituted for *jade* and *brigand.*

The Story

The story was modified during the Pilot study to make the meaning of the experimental words less explicit thus increasing the demands for inferring meaning from this context. The final story was taped and the makeshift illustrations were replaced with attractive coloured pictures professionally drawn and coloured, and ring bound into a book. The full story and pictures are included in Appendix 12.

The Explicit Teaching Context

Following the pilot study the form of the definition given about each new word was changed to make it less repetitive and more natural. In addition, the number of times that the category and attribute of each word was provided verbally was reduced to twice in keeping with the amount of exposure given to these aspects of meaning in the story. (The meaning was of course also available from the pictures.)

Because of these changes, which might make the words more difficult to learn, the number of repetitions of each word was increased from five to six in both contexts. The pictures and text for the Explicit Teaching context are included as Appendix 13.

3.3.2 Word learning assessments

The Picture Comprehension test

The Picture Comprehension test was altered following the pilot study. In its original form it attempted to establish by pictorial means whether the child had learned the category and attribute of each experimental word. Following piloting, it was felt that the method of ensuring the pictures were correctly interpreted was rather lengthy. In any event, the addition of the Word Description task (see below) together with the Meaning Recognition test assessed the child's knowledge of semantics for the experimental words. Furthermore as a pair of tests designed to test semantic learning, they shared characteristics of assessment style with the pair designed to assess phonological learning.

It was nevertheless decided to keep the Picture Comprehension test since this is a common means of assessing vocabulary in experimental and clinical contexts but it was revised to make it shorter.

In the new version, children were asked to select the named experimental word from a choice of four pictures (the target and the three other experimental words). The choice of these items as distracters reduced the chances of children selecting the target item simply because they remembered the picture from the learning context or by a process of elimination from other more familiar distracters.

The test format was comprised of a large photograph album with a 2x2 matrix of pictures arranged randomly on each of eight pages. Each set of four pages tested each word once. Therefore in the course of the test each word was tested twice and with a possible score of one point for each item correct giving a possible total score of eight. The order in which each word is tested was random. The only constraint on order is that the same item was not asked for twice in a row. There are two versions of this test which vary only in the ordering of items and these were counterbalanced across learning trials. The test items are included as Appendix 8.

The Word Description Test

During piloting, assessment of the child's knowledge of word meaning was extended to include a task in which the child was asked to provide descriptions or definitions for the experimental words. This task was then adopted as an assessment of word learning in Studies 1 and 2. The Word Description test ensured that children's scores for knowledge of meaning could be assessed without the possibility of scoring correctly by chance. In this way like the Naming test, it made demands on the production of information rather than the recognition of information. It was therefore considered to be a more reliable and stringent measure of a child's semantic knowledge about the new words. The test form is included as Appendix 9.

In addition to these more major changes, wording and directions for tasks were modified in accordance with experience of testing children during the Pilot Study.

CHAPTER 4 STUDY 1: WORD EQUIVALENCE

4. Introduction.

In this chapter, Study 1 will be described. This investigated whether or not the two sets of words selected for word learning and described in Chapter 3 were equally easy to learn. Study 1 was carried out so that, if appropriate, an analysis of the effect of context on word learning could be included in Study 2. (This would be confounded if the word sets differed in how easy they were to learn).

Study 1 also served as a further pilot study because it identified the need for modifications to the Pre-test and to the Word Recognition Test before the main study of word learning, Study 2.

4.1 Research Question for Study 1

The research question for Study 1 was as follows:

- Are the experimental words to be presented in the Story context as easy to learn as the words to be presented in the Explicit Teaching context?

4.2 Method

4.2.1 Design

The research design involved comparing two groups of children matched for nursery attended and gender but otherwise randomly allocated to an experimental group for the purposes of the study. One group was presented with the words from the Explicit Teaching context and the other group was presented with words from the Story context. Both sets of words were presented as if in the Explicit Teaching paradigm.

4.2.2 Participants

Ethical approval was sought and granted from Lothian Region Education Department. Two nurseries in mixed catchment areas were chosen and nursery head teachers asked to suggest children between 4 and 5 years old for whom English was their first language and who had no speech, language or hearing problems. In order to obtain the 28 children required in the study, informed consent was sought from parents of a larger number than this (42 children in total).

Twenty-eight children, 12 girls and 16 boys were placed in one of two groups: Group S or Group E. Group S were taught the words which would be used in the Story context in Study 2. Group E were taught the words which would be used in the Explicit Teaching context in Study 2. The groups were matched for numbers of children from each nursery and had equal numbers of boys and girls. Otherwise the children were randomly allocated to a group. The age range of the children was 50 - 64 months and the average age in each group was similar: 57 months in the group learning the Story context words and 58 months in the group learning the words from the Explicit Teaching context. In addition, head teachers were asked to confirm that the groups were roughly equivalent with regard to background and ability.

Children were excluded because of significant developmental speech disorders (n=4), English as a second language (n=1), reluctance to participate (n=1), or because on the pre-tests they failed the criteria for inclusion in the learning study (n=8). A total of 28 children remained in the study.

4.2.3 Materials and procedure

Children participated individually on two consecutive days in a room adjoining the nursery classes. On the first day, the pre-test was administered. Following a break back in the nursery, the children returned the same morning for the first learning opportunity and related assessments. On the second day there was no pre-test. The learning opportunity was exactly the same as on the first day. The assessments were also the same except that the items in each of the assessments were presented in a different order.

The Pre-test

The pre-test was used to establish whether the experimental words were unfamiliar. The children were asked to listen to a series of 16 words including the experimental words and say whether they had heard each word before. They were also asked about the meaning of each word. The Pre-test has already been described more fully in Chapter 3 section 3.1.5.1 along with the criteria for passing it in section 3.3.

The learning opportunity

The words were presented to the children as if in the Explicit Teaching context and therefore the learning opportunities for both sets of words were exactly the same. There were individual coloured pictures on large white laminated cards 15 cm x 21cm for each of the four words in Set S (aster, polka, molasses and phial) and Set E (mica, gauntlet, albatross and kale). At the start of the learning opportunity one set of cards was shuffled and placed face down on the table. The child was asked to choose a card thus ensuring random presentation of the experimental words. Then the child heard each word defined according to the standardised script from the Explicit Teaching context. This included six repetitions of each word's pronunciation and two presentations of each type of information about its meaning (category and attribute). The script for the word *mica* was as follows:

"*Now we'll look at the* ***mica*** *. OK this is* ***mica. Mica*** *is a kind of stone.* ***Mica*** *is a shiny stone. Can you see how shiny this* ***mica*** *is? Right we'll put the* ***mica*** *away and do another one.*"

The measures of word learning.

The five measures of word learning viz: Naming, Word Recognition, Word Description, Meaning Recognition and Picture Comprehension were presented in a fixed order after each learning trial. These assessments have already been described in Chapter 3, sections 3.2.2 and 3.3.2

4.3 Results

4.3.1 Comparison of word sets

Results for word sets Set S and Set E were compared for each of the measures and for the sum of these, after the first and second learning trials (Time 1 and Time 2). These results are presented in Tables 4.1 and 4.2. The results from the two word sets were compared statistically using a non-parametric test. This was appropriate because the data on a number of measures were either positively or negatively skewed due to ceiling or floor effects. Since parametric tests assume a normal distribution, the non parametric Mann-Whitney-U test based on differences between ranks rather than individual scores was used.

Time 1

Table 4.1 presents descriptive and inferential statistics for the assessments after the first learning trial (Time 1). It can be seen that the median scores on all measures with the possible exception of Meaning Recognition were very similar for both the Set S words and the Set E words. Mann Whitney-U tests showed that there was no significant difference at the 0.05 level between the scores for any of the measures or for the sum of them.

Table 4.1 Median scores, range and significance levels (Mann Whitney test) for measures of word learning comparing the two word sets at Time 1.

Time 1	Naming /8		Word Recognition /8		Word Description /8		Meaning Recognition /8		Picture Comprehension /8		Total /40	
Word Set	**S**	**E**	**S**	**E**	**S**	**E**	**S**	**E**	**S**	**E**	**S**	**E**
Median	0.5	0	6	5.5	2.5	3	4	6	4.5	4.5	18.5	17
Range	0-4	0-4	4-8	2-8	0-8	0-8	1-8	1-8	3-8	1-8	8-35	6-35
Mann Whitney U=	211.5		232.5		197.0		177.0		207.5		209.5	
p=	0.6852		0.1827		0.7984		0.2370		0.8514		0.7818	

S= Words from Story context E= Words from Explicit Teaching context

Time 2

After the second learning opportunity (Time 2), the median scores of the assessment measures for each set of words were also very similar. Mann Whitney-U tests confirmed that any differences between the medians were not significant at the 0.05 level. Descriptive and inferential statistics at Time 2 are presented in Table 4.2.

Table 4.2 Median scores, range and significance levels (Mann Whitney Test) for measures of word learning comparing the two word sets at Time 2.

	Naming /8		Word Recognition /8		Word Description /8		Meaning Recognition /8		Picture Comprehension /8		Total /40	
Word Set	S	E	S	E	S	E	S	E	S	E	S	E
Median	2	2	8	7.5	5	5	6	6	7	6.5	26	27.5
Range	0-7	0-7	5-8	3-8	2-8	2-8	4-8	1-8	5-8	1-8	23-39	9-38
Mann Whitney U=	221.5		209.5		218.5		197.5		225.5		212	
p=	0.3959		0.7630		0.4850		0.8128		0.2875		0.6954	

S= Words from Story context E= Words from Explicit Teaching context

4.3.2 Distribution of scores

On some tests such as Word Recognition and Picture Comprehension at Time 2, the median scores were close to the maximum. On others such as Naming and Word Description at Time 1 the median scores were close to the minimum. This prompted a review of the measures to consider whether marked floor or ceiling effects were occurring. According to Coolican (1995) when a test is relatively easy and there are ceiling effects, this results in a negatively skewed distribution of scores. Conversely when a test is relatively difficult (with floor effects), this results in a positively skewed distribution.

Bearing in mind that Study 2 would include a much wider age range of children because of both age and vocabulary matched controls, it was important to establish whether measures would lose their sensitivity in the older children because they were too easy or in the younger children because they were too difficult. Table 4.3 shows the percentage of children who scored no points (at floor) or full points (at ceiling) on each measure for each word set.

Table 4.3 Percentages of children who obtained scores either at ceiling or floor on the measures after each learning opportunity

	Floor		Ceiling	
Time 1	**Set S**	**Set E**	**Set S**	**Set E**
Naming	50	57	0	0
Word Recognition	0	0	29	14
Word Description	29	14	7	7
Meaning Recognition	0	0	7	21
Picture Comprehension	0	0	7	14
Time 2	**Set S**	**Set E**	**Set S**	**Set E**
Naming	14	36	0	0
Word Recognition	0	0	57	50
Word Description	0	0	29	14
Meaning Recognition	0	0	29	43
Picture Comprehension	0	0	43	43

Floor effects

At least half the children failed to score on the Naming assessment at Time 1. Floor effects also occurred on the Word Description test at Time 1, but these were much less pronounced than on the Naming measure. At Time 2, Naming was the only test on which floor effects occurred although with the additional repetition provided during the second learning opportunity, the percentages of children scoring zero had dropped considerably for both sets of words.

Ceiling effects

Ceiling effects were also apparent. At Time 1, the percentages of children scoring full points on any measure were quite low (under 30%). However by Time 2, 50-57% of children were scoring at ceiling on the Word Recognition test. Ceiling effects were also more pronounced on all other measures except the Naming test although the percentages were always less than 50%.

4.4 Discussion

The aim of Study 1 was to investigate whether two sets of words were equally easy to learn. This was necessary because the word sets were to be used in different contexts. In order to make any claims about the effect of context on children's word learning, the words would have to be equally easy to learn. Study 1 found that this was the case for the words to be used in the Story context and in the Explicit Teaching context.

4.4.1 Floor and Ceiling effects

As stated in section 4.3.2., ceiling and/or floor effects occurred on some of the assessment tasks. These have occurred in other research with children who have developmental language difficulties (Bernstein & Stark, 1985; Bird & Bishop, 1992) but it is desirable to reduce these if possible. The ceiling effects noted on the Word Recognition test which might make it less sensitive to differences between the groups in the forthcoming Study 2 prompted a review of this test to see why so many children were scoring so well.

It will be recalled that the Word Recognition test required the child to listen to and select the correct pronunciation of a word from a choice of four in order to score two points. This gave children a 25% chance of scoring two points by guessing the answer. However if the child selected either of the two close distracters, a score of one was awarded. This meant that the child also had a 50% chance of achieving a score of 1 by guessing. Overall the odds of scoring something on this test purely by chance was 75% compared with at best a 25% chance on the other recognition tests such as Picture Comprehension and Meaning Recognition. It was therefore decided to modify and extend this test to reduce the opportunity of scoring by chance and these changes are described in section 4.4.2.

It was decided not to modify the other measures of learning and to accept that some floor and ceiling effects would occur. The research design proposed for Study 2 compares three groups of children: one with SLI, a control group matched for vocabulary age and a control group matched for chronological age. Because children with SLI are likely to score considerably below their age for vocabulary, the control group matched for vocabulary will be considerably younger. Therefore it is possible that chronological ages in the three groups may differ by as much as four or five years. This makes it very difficult to eliminate floor and ceiling effects. For example if the tasks are made more demanding to reduce anticipated ceiling effects in the older chronological age matched control group, the much younger control group matched for vocabulary age will most likely experience floor effects. One aspect of the design that might ameliorate this problem is the fact that the research design studies word learning over two trials, i.e. with limited exposure at Time 1 and then after further exposure at Time 2. This will mean that floor effects occurring at Time 1 are likely to be reduced or absent at Time 2 . Conversely ceiling effects occurring at Time 2 may not be present at Time 1. This pattern was apparent in Study 1.

It will be recalled that in Study 1, eight children were excluded because they failed the pre-test. However when administering this, it was felt that some children were being excluded from the study because they were not coping with the procedure. That is, the pre-test seemed to be excluding children for reasons other than familiarity with the experimental words. It was feared that this problem would be greater if children had not only one but two pre-tests (one for each word set) to pass before inclusion in Study 2. For this reason it was also decided to modify the Pre-test.

4.4.2 Modifications to assessments

Although the main purpose of Study 1 was to compare the two word sets, the study also allowed for more detailed piloting of the experimental paradigm. This resulted in modifications being made to the Pre-test and to the Word Recognition test.

A new Pre-test, in a different format which was much shorter (12 items instead of 32) was devised for Study 2 and is described more fully in Chapter 5 (section 5.4) and is included in Appendix 10. It was hoped that these changes would reduce the likelihood of children being excluded from Study 2 because they had difficulty with the format of the Pre-test.

The Word Recognition test was modified to counteract the problems of a high chance of scoring at least 1 point by eliminating the graded scoring system for each item and adding four more items. Thus it was extended to eight trials, two for each word with a 25% chance of achieving 1 point on each. This made the child's chance of choosing correctly by guessing the same as in the other recognition tests. The revised Word Recognition test is included as appendix 11 and described in section 5.8.

4.5 Summary of Study 1

Study 1 fulfilled the aim of establishing that the words to be presented in each learning context were equally easy to learn. If appropriate, this would enable differences between the two learning contexts in which they were presented to be evaluated in Study 2.

Study 1 also served as a more detailed pilot study because it involved a larger number of children and used the materials which had been modified during the original pilot study. Analyses of the data from Study 1 suggested that the Pre-test was more problematic than was first apparent and that the Word Recognition test in the form used in Study 1 allowed children a high probability of achieving a score by guessing. These experiences of the test materials in Study 1 allowed the assessments to be further refined in preparation for Study 2.

CHAPTER 5 A STUDY OF WORD LEARNING IN CHILDREN WITH VOCABULARY DEFICITS: ISSUES AND METHOD FOR STUDY 2

5. Introduction

This chapter describes the methodology for Study 2. It begins with a brief outline of the research aims for Study 2, followed by a summary of the method adopted. Much of the chapter is devoted to a description and discussion of the particular methodological approaches and difficulties described in the literature in relation to children with SLI and their controls. The specific resolution of these issues in Study 2 is described. Finally the experimental procedure and materials and the way in which the experimental contexts and measures were counterbalanced are described.

5.1 Research aims and overview of Study 2

Study 2 aims to establish the <u>extent</u> and <u>nature</u> of any word learning difficulties experienced by a group of children whose SLI includes lexical difficulties.

To address these aims the acquisition of new words by children with SLI and a vocabulary deficit was compared to two groups of children with normal language development. Children in both control groups were <u>individually matched</u> to the children with SLI on variables of relevance to vocabulary development. Significant differences in performance between the children with SLI and the age matched and younger language age matched groups would indicate the <u>extent</u> of any word learning problems.

Vocabulary learning in all three groups was studied in two contrasting contexts. Each context provided semi-naturalistic opportunities for the introduction of four unfamiliar words. In the <u>Story</u> context, no specific attention was drawn to the unfamiliar words and no definitions of their meanings were given. Instead the meanings could be deduced from the story and its accompanying pictures. In the Explicit Teaching context the unfamiliar words were presented one by one accompanied by a picture and a simple definition. The set of four words from each context had already been shown to be equally easy to learn by a group of normally developing pre-school children. (See Study 1, Chapter 4)

Children's learning was measured using five assessment tasks which differentially emphasised semantic or phonological learning. These were carried out following the learning opportunity for each set of words on each of two consecutive days. It was considered that the short gap in time between learning opportunities might make it easier for children to retain information from the first to the second learning trial. As a result, children might score more highly after the second learning opportunity because they had added to their existing knowledge about the words. It was hoped that this aspect of the design would allow differences between the groups to emerge more readily. For example in the event of floor effects after the first learning trial these might be ameliorated after Time 2 when the children had had more exposure to the experimental words. In addition, a second learning opportunity so close to the first would also allow the effect of extra exposure to the unfamiliar words to be studied.

It was anticipated that the results from the two different contexts, the different assessment tasks and each of the two learning trials would provide insights into the nature of any word learning difficulties experienced by the children with SLI.

5.2 Recruitment and selection of children with SLI

5.2.1 Criteria for referring children with SLI to Study 2

Ethical permission to include children with Specific Language Impairment was separately sought from, and granted by, two Health Boards in central Scotland (Fife and Lothian). As a first step in identifying children, Speech and Language Therapists throughout Edinburgh and those working in Language Units in Mid Lothian and West

Lothian and Fife were asked to suggest children who might fulfil the following criteria for inclusion in the research:

- Specific language impairment (SLI) including a significant vocabulary deficit. As stated in Chapter 1, the term SLI implies developmental language difficulties but non-verbal intelligence within the normal range. Significant vocabulary deficit was defined as a standard score more than one standard deviation below the mean on the long form of the British Picture Vocabulary Scale. If this test had not been administered, the therapist might refer a child if he/she judged that a score in this range was likely. Further testing (see section 5.2.2) was carried out by the experimenter to confirm whether the child fulfilled both the above criteria.

- Age 6-8 years old inclusive. (The age range was later extended to include children from 5 years 6 months-9 years because of difficulty in recruiting subjects.)

- No current hearing loss.

- First language English.

An information sheet about the study and forms to obtain informed consent (See Appendix 14) was circulated to each of the 48 families of children with SLI who were referred to the Study over a period of several months. Forty-six families agreed to let their child participate in the research.

5.2.2 Criteria for selecting children with SLI for Study 2

All children whose parents had given informed consent were assessed for participation in the study. The assessments administered were the same as those given to the control groups and included a measure of non-verbal intelligence, the Block Design of the Weschler Intelligence Scale for Children (WISC) (Wechsler, 1992) or the Weschler Pre-school and Primary Scale of Intelligence (WPPSI) (Wechsler, 1990) and the short form of the British Picture Vocabulary Scale (BPVS) (Dunn et al., 1982).

There were two reasons for using these tests. The first was to confirm whether the children with SLI fulfilled further criteria for inclusion in the study. These were a significant vocabulary deficit defined as a standard score greater than one standard deviation below the mean (i.e. less than 85) on the short form of the BPVS, and a score within the normal range (i.e. greater than 7) on the Block Design subtest.

The second reason for using these tests was to identify individual scores against which to match children in the two control groups. For a full discussion of the choice of matching variables and assessments see Section 5.3.

At this stage the Pre-test was also administered to ensure that the experimental words to be used in the learning trials were unfamiliar to the child. The Pre-test used in Study 2 is described fully in Section 5.4.

Children with SLI were excluded from the study if their standard score for vocabulary fell within the normal range, if their score on Block Design fell below the normal range, or if they identified a picture of any of the experimental words correctly on the Pre-test.

Of the 46 children whose parents gave permission for them to be included in the study, only 17 were finally selected to participate in the learning trials following assessment. This number was reduced to 16 when a child was excluded on the basis of his very high Block Design score which would have made matching difficult.

5.2.3 Loss of participants with SLI from Study 2

Unfortunately the numbers above represented a considerable loss of potential subjects from the study and at first sight this may seem somewhat remarkable. Reasons for exclusion require closer scrutiny and are first presented in Table 5.1 and then discussed.

Table 5.1 Children with SLI excluded from Study 2

Reasons	Familiar with word(s) on Pre-test	*BD SS below 1 Standard Deviation	** BPVS SS in normal range	Other
No of Children	9	14	5	2

* Block Design Standard Score ** British Picture Vocabulary Scale Standard Score

On most occasions assessment was carried out in the order Pre-test, Block Design, BPVS, and discontinued as soon as it was clear that a child did not fit the criteria for the study. Occasionally however the order of assessment was altered or it was not possible to score an assessment at the time. As a result, two children were excluded on the basis of more than one assessment. In one case a child who was excluded on the basis of the pre-test also had a BPVS standard score within normal limits. Another child excluded by the Pre-test also had a Block Design score below the average range.

Nine children were excluded on the basis of their responses to the Pre-test. It was later confirmed through parents or teachers that some children did indeed know an experimental word. Other children however may have been excluded because they guessed correctly. A very few children found the procedure too difficult and were unable to comply.

The majority of children were excluded because their Block Design standard score was significantly below average. It could perhaps be argued that this particular measure of non-verbal ability may have given an inaccurate indication of these children's non-verbal ability especially since the children were often in placements for children with specific language disorders. However the justification for the choice of this measure is described in Section 5.3.3. Furthermore even if the picture completion subtest of the WISC or WPPSI had also been administered and the average of the two subtests taken as in the study by Bird, Bishop, & Freeman (1995), a number of children may still have failed to qualify because their Block Design score was very low indeed and would probably have depressed the overall mean.

Yet other potential subjects were excluded because their score on the BPVS fell within the normal range. Such exclusions may result from an artefact of the test. That is a child may perform differently according to the version of the test used. In the test manual the authors give figures for approximate inter-form reliability between the short and long forms. Correlation coefficients for ability scores between the two forms in the age groups in Study 2 vary from .43 to .70. Given the size of these correlations it is possible some children who score below one standard deviation of the mean on the long form may score higher on the short form and no longer fulfil the criteria for inclusion in the study.

The reasons for using the short form are discussed in Section 5.3.4, and the loss of some potential participants could not therefore be avoided.

Finally two children were excluded for other reasons. One child's assessment results were not considered reliable due to the circumstances of assessment (a noisy and disruptive home). Another child had such a high score for Block Design it was considered that finding matched controls would be extremely difficult.

Thus the measures used in this second stage of subject selection may have inappropriately reduced the number of children participating. Alternatively however, a number of these children may not have fulfilled the criteria because the Speech and Language therapists referring the children overestimated their cognitive ability or degree of vocabulary deficit.

The latter explanation seems plausible for some cases at least, if we refer to the problems experienced by Stark & Tallal (1981) who found that only 39 of the 132 children referred to their project fulfilled their criteria for SLI. Interestingly most of the exclusions from this study were due to low performance IQ. However others were excluded because their receptive or expressive language was too high for the study's criteria.

The language characteristics of the 16 children with SLI at the time of Study 2 are described in the following section.

5.2.4 Language profiles of the Children with SLI

All the children scored at least one Standard Deviation below the mean on the short form of the British Picture Vocabulary Scale because this was one of the criteria for inclusion in the study.

Over and above this, the characteristics of the group's SLI according to their test performance at, or close to, their participation in Study 2 is described. All tests (with the exception of the short form of the BPVS) were carried out by the child's own speech and language therapist as part of their ongoing management and it was not possible to repeat these. Because of the different ages of the children, and the fact that there is a range of tests available from which therapists make individual choices according to preference, the tests carried out varied. For example some children had their comprehension assessed on the Reynell Developmental Language Scales (Reynell and Huntley, 1985), other children had been tested on the Test of Reception of Grammar (Bishop, 1982), and yet others on the Clinical Evaluation of Language Fundamentals (Semel Wiig and Secord, 1987). In addition the timing of testing also varied. The description of the children is therefore based on assessment results and therapists' observations closest to the time of the study.

Language Comprehension

This refers to children's ability to understand language. On the basis of test results obtained from their own therapists, children were divided into three groups corresponding to the extent to which their comprehension scores were lower than their age. (over and above problems on the British Picture Vocabulary Scale). Five children (31%) had scores equivalent to 2 years or more behind their age on any comprehension test. Eight children (50%) had scores no more than 20 months below their CA on any comprehension test, and two children (13%) had scores less than 6 months below their chronological age. There was insufficient information about one child (6%) to categorise him. The available data suggested however that on one subtest of a receptive language scale, his comprehension was not in the normal range for his age.

Expressive language

This refers to children's ability to express themselves verbally. All but one of the children had some degree of difficulty with expressive grammar and fourteen children (87%) had poor expressive vocabulary in addition to their receptive vocabulary problems. Of the remaining two children, one scored age appropriately for expressive vocabulary despite having a poor receptive vocabulary, and there was no information about expressive vocabulary level for the other child.

Phonological Development

This refers to the children's development of the appropriate pronunciation patterns for speaking their language and was judged by the researcher, a qualified speech and language therapist from the children's speech during Study 2. Most of the children in the study did not have significant pronunciation problems. However two of the children (13%) still had a significant phonological disorder (i.e. errors of pronunciation that are not secondary to any obvious physical problems with the organs of speech) at the time of Study 2. A further three children (19%) had minor or residual phonological errors.

Social Communication

This refers to the child's ability to use their language appropriately in social settings. It includes conversational skills such as maintaining a topic, taking turns to speak and non verbal communication such as appropriate eye contact and facial expression. Eight children (50%) had some difficulty with social communication skills. In two of the children (13%), this difficulty was severe.

Appendix 15 summarises the range of difficulties children had. It shows that most children had widespread language difficulties affecting both comprehension and expression at the time of Study 2. Eight children (50%) also had problems with the social use of language. Not surprisingly, while participating in Study 2, 13 of the children (81%) were placed in five different full or part time language units (special educational provision for children with moderate-severe speech/language problems). The other three were in mainstream primary school classes and known to the community speech and language therapy service.

5.3 Rationale for the choice of matching variables

Before describing the recruitment and selection of children with normal language development for the control groups, the rationale and procedure for individually matching the children with normal language development to the group with SLI will be described.

Matching variables included age, gender and non-verbal intelligence in the age matched control group (CAC) and vocabulary age, gender and non-verbal intelligence in the vocabulary-age matched control group (VAC).

5.3.1 Age

Although initially vocabulary development starts slowly, as children get older their rate of vocabulary development increases, with peak rates of growth, according to Nagy and Herman (1987), occurring in the school years. The increase in the rate of acquisition with age may occur because learning skills, world experience and strategies are more highly developed in the older child. In addition the larger vocabularies of older children may assist in learning both phonological and other aspects of new words (Gathercole, Hitch, Service, & Martin, 1997). Older children may also cope better with the contexts and tasks used in an experimental paradigm because of better attention. A control group matched for age makes it possible to explore the extent of the gap between language impaired children and their peers.

Chronological age matched controls were individually matched to within two months of age to the child with a vocabulary deficit.

5.3.2 Gender

Although no specific evidence is available on gender differences in the acquisition of new vocabulary, it is possible that the learning contexts and the test materials might appeal more to one gender than the other. Such differences in interest or motivation to attend, might affect learning and it was decided that it was also prudent to match all children on this variable.

5.3.3 Intelligence

There is a definite relationship between children's overall intelligence and their vocabulary development as measured by intelligence tests such as the Weschler Intelligence Scale for Children (WISC) (Wechsler, 1992) and the Weschler Preschool and Primary Scale of Intelligence (WPPSI) (Wechsler, 1990). On the former, the vocabulary subtest correlated more highly with the overall score than any other subtest and on the latter vocabulary had the second highest correlation. This suggests that more able children may learn words more easily. The reasons for this may include better strategies for learning generally, the effect of other abilities or greater curiosity about new words. For this reason, a difference in intelligence between the groups would be a potential confounding variable and therefore matching for intelligence was also carried out.

A measure of *non-verbal* ability was chosen to match the children because the performance of children with SLI on verbal subtests is likely to be affected by their language difficulties. Because of resource constraints and because many of the children with SLI are given intelligence tests as part of their overall assessment for school placement it was not appropriate to carry out a full test of non-verbal intelligence. Consequently the Block Design sub-test of the WISC or its downward extension the WPPSI was chosen to match children for intelligence. Together these

tests cover the age range of children likely to be included in Study 2. For the WPSSI, the age range covered is 3 years 10 months and 16 days through to 6 years 7 months and 15 days. The WISC covers the age range 6 years to 16 years 11 months.
The Block Design was particularly chosen from a range of subtests because on the WPPSI the average intercorrelation between it and the full scale score for the six age groups is higher than for any other performance subtest (.61). It also has the second best average intercorrelation with the performance score (.59), for the six age groups. On the WISC the Block Design also had the highest correlations (of all the performance subtests) with both full scale and performance IQ between 6-10 years. Furthermore it has been used, together with picture completion, for matching children with SLI to controls in previous studies (Bird & Bishop, 1992; Bird et al., 1995).

Children in the control groups were individually matched to within two points of the standard scores of the children with SLI.

5.3.4 Language level - Size of existing vocabulary

In exploring the nature of vocabulary deficits it may be possible to establish whether the pattern of results indicates developmental delay or difference. One might conclude that children with SLI are 'developmentally different' if they perform more poorly than children at a similar stage of language development.

Language however is a very complex skill and it is difficult to select one measure for matching which reflects the child's total language ability. Furthermore it is likely that more than one facet of a child's language development may affect word learning. For example it has been suggested that knowledge of grammar (Rice et al.,2000) and vocabulary (Gathercole et al., 1997) both play a part.

There is disagreement in the literature about whether the level of a child's existing vocabulary affects the ability to learn new words (Gathercole & Baddeley, 1989; Gathercole et al., 1997; Kiernan and Gray, 1998; Gathercole, Willis, Emslie, & Baddeley, 1992; Rice, Buhr, & Oetting, 1992; Rice, Buhr, & Nemeth, 1990; Rice, Oetting, Marquis, Bode, & Pae, 1994). Nevertheless because there is some evidence that children's current vocabulary knowledge is significantly correlated with a range of word learning tasks, particularly those which involve acquiring unfamiliar phonological forms (Gathercole et al., 1997), it was decided to use the level of receptive vocabulary on the British Picture Vocabulary Scale for matching language-age controls.

This choice of matching variable has also been used in other studies of word learning or vocabulary deficits (Constable, Stackhouse, & Wells, 1997; Haynes, 1982).

In choosing to match control children on this variable however it is recognised that this will not reflect all aspects of a child's language development thought important for word learning. An alternative would have been to include yet another control group as in the study by Dockrell, Messer, George, & Wilson (1997) where separate groups were matched on understanding of grammar and for naming vocabulary. However it was not possible within the constraints of the present study to have more than two control groups. Nor was it possible to match the same child for both vocabulary and grammar. The characteristically uneven profiles of many language impaired children would have made this impossible for many subjects.

In Study 2, language controls were matched to the children with SLI for their performance on the short form of the British Picture Vocabulary Scale (Dunn & Dunn, 1982). It was not possible to use the long form of the test because many of the SLI group had already been assessed on the long form by the referring speech and language therapists as part of an overall assessment battery. In the case of a recent assessment it would not be appropriate to repeat the same form of the test because it is generally accepted that a gap of 6 months should be left before reassessment.

Scores obtained on the BPVS include age equivalent levels and confidence intervals, a standard score and a percentile rank. Because the criterion for matching is the size of the child's vocabulary, the age equivalent score has been used. Other scores (percentile ranks and standard scores) indicate a child's level of performance relative to others of his/her age. If children were matched according to either of these scores, unless they were the same age, they would not have the same size of vocabulary.

Although it was decided to use the age equivalent score on the BPVS to match children for vocabulary level, there are also some problems with using it. Firstly, all tests are imprecise instruments, and age equivalents may not be an accurate reflection of a child's level of vocabulary development. Certainly Dunn et al. (1982) suggest that "caution must be used in interpreting age equivalents because the scale units are unequal". Despite this shortcoming no suitable alternative was found, and children were matched for age on the short form of the BPVS.

5.3.5 Final choice of matching variables

The variables chosen for matching the two control groups to the SLI group are displayed in Table 5.2 and summarised below.

Both control groups were individually matched for gender to the children with SLI. In addition the Block Design Standard Score of every child in the control groups had to be within the average range (7-13) and individually matched to within 2 points of the child with SLI. Each child in the CAC group was also individually matched to within 2 months of age to a child in the SLI group. The vocabulary age of children in the CAC group had to be within the normal range but was inevitably higher than the child with SLI whose score was outwith the normal range. The vocabulary age of each child in the VAC group had to be within the normal range on the short form of the British Picture Vocabulary Scale and individually and exactly matched to a child in the SLI group. Consequently the children in the VAC group were often considerably younger than children in the SLI group.

Table 5.2 Matching Variables for control groups in Study 2

	Age	Gender	*BD SS	**Vocabulary age
Chronological age controls (CAC)	Within 2 months	yes	Within 2 points	
Vocabulary age controls (VAC)		yes	Within 2 points	Age equivalent score (exact match)

*Block Design Standard Score (from Weschler Intelligence Scale for Children or Weschler Preschool and Primary Scale of Intelligence)
**British Vocabulary Scale Short Form

5.4 The Pre-test

In the first session prior to the learning contexts, the BPVS, the Block Design subtest and the Pre-test were carried out. The Pre-test was administered to establish that the experimental words were unfamiliar. It was revised following Study 1 and therefore differs from the description in Chapter 3. Its final version was as follows:

The child was shown a series of 12 pages in a loose leaf binder. On each page were six pictures (three down each side) and a blank square (the 'empty box') in the middle.

To decrease the chance of the child selecting an experimental word by eliminating familiar items, each page included some pictures of unusual items e.g. scientific or medical instruments. For example on the page testing the word *phial,* distracter pictures included a trowel, a bandstand, a sextant, a metronome, and an igloo. The child was asked to find the item named from the array but was encouraged to point to the 'empty box' if the word was not known. As well as the eight experimental words tested, four pages 'testing' common words were interspersed among the items at random to evaluate the accuracy of the child's response generally and to give the child an opportunity to demonstrate that he/she knew some words. Instructions were as follows:

"I'm going to say some words to you and I want you to point to the right picture. Some of the words I say you won't have heard before. If you don't think you've heard the word before point to the empty box. Let's practise first".

Three practice items were administered with feedback and then the experimental words were tested in random order. Children were included in Study 2 as long as they did not select the correct picture for any experimental word. Confirmation that the word was unknown included both 'empty box' responses or selection of the wrong picture. A full copy of the pre-test form is included as Appendix 10.

5.5 Recruitment and selection of children with normal language development for control groups

Ethical permission to approach schools and nurseries to recruit children with normal language development was obtained separately from the City of Edinburgh Education Department and from the Psychology Department of Edinburgh University.

Subsequently, the head teachers of individual schools and nurseries were approached individually to request their co-operation in the study. A total of eight nurseries and three primary schools agreed to participate.

5.5.1 Chronological age-matched controls (CAC)

Head Teachers were asked to provide the school roll with dates of birth for all children in the age range required by the study. All children were considered potentially suitable for the study unless, following consultation with teaching staff, any of the following applied:

- Permanent hearing loss
- Current speech and language delay or disorder
- English not their first language.

Staff also identified children with significant special needs e.g. children with autism, overall developmental delay etc., and those with poor attendance and it was decided to exclude these children from the study. Thereafter children were selected from the school roll and individually matched for gender and to within two months of age to the children with SLI. The parents or guardians of these children were provided with information about the nature of the study and a consent forms (see Appendix 16). Eighty parents gave permission for their child to be involved. Thereafter children were included in the study if their standard score on the Block Design subtest of the WISC or WPPSI individually matched that of the child with SLI; if their BPVS score was within the normal range; and if they did not know any of the experimental words on the pre-test.

It was not necessary to see all 80 children for whom consent was given because matched controls were identified before all the children were assessed. From the 64 children assessed, 16 age matched controls were identified. In addition, one child's scores meant that she was appropriate as a vocabulary age matched control.

5.5.2 Children excluded from the CAC group in Study 2

Many more children with normal language development were assessed than were eventually included in the study. This was largely as a result of the matching criteria.

The majority of children (n=20) were excluded because their Block Design score did not match any of the children with SLI. The next largest category consisted of children (n=11) who correctly selected one or more of the experimental words on the pre-test. This meant that at least one of the words assumed to be 'new' to the child was already familiar and would therefore affect the child's performance on the learning trials. Six children were excluded because their block design standard scores were below one standard deviation of the mean and a further four children's receptive vocabulary was also below one standard deviation below the mean. Finally, seven children were excluded for a variety of other reasons. These included children who had been selected as reserves but were not required. (Reserves were identified when there was an <u>additional</u> matched control for a particular child. If the first child identified as a matched control was able to complete the learning trials, the reserve was not required.) One child was judged by the researcher to have significantly immature speech and language and another had significant reading difficulties. Both these children were also excluded from the study.

5.5.3 Language (Vocabulary) age matched controls (VAC)

From the nursery school roll, children were selected to individually match the children with SLI for gender. As for the age matched control children, staff were asked to exclude children from the list if any of the characteristics described in section 5.5.1 applied. Again staff also excluded children with poor attendance and those with significant special needs.

The families of these children were then approached with the same information and consent form as the CAC group. A total of 121 forms was distributed. Consent was given for 94% of children. In one nursery there was no requirement to approach parents individually as permission had been given for children to participate in properly monitored research activity on entry to nursery.

Children were seen individually and first assessed on the short form of the BPVS. Those whose vocabulary age matched a child with SLI were then assessed on the Block Design Subtest of the WPPSI (to establish that their score was within the average range and whether they matched children with SLI for non-verbal intelligence) and then on the pre-test to ensure the experimental words were unfamiliar.

Because in the VAC group children were matched for both vocabulary level <u>and</u> non verbal intelligence, it was necessary to see more children than in the age matched group where children only had to match on one test score (i.e. Block Design). One hundred and five children were seen and from these 15 matched control children selected. Together with the one child identified as a VAC when testing for age matched controls, this made a total of 16 children in the VAC group.

5.5.4 Children excluded from the VAC group in Study 2

Most children (52) were excluded because their vocabulary age did not precisely match the children with SLI. However a proportion of children (7) who did match on this variable failed to match on the Block Design subtest of the WPPSI and one of them also scored outwith the normal range on this test. Eleven children were excluded because they selected one or more of the words on the pre-test indicating some possible familiarity with the experimental word(s). Of concern was the number of children (10), whose standard score on the British Picture Vocabulary Scale was outwith the normal range. Even if these children had matched a language impaired child, their poor level of vocabulary development (in the impaired range) immediately excluded them from the study. Ten children were excluded for a variety of other reasons including refusal to participate, unreliable responses, a pronunciation disorder etc.

Table 5.3 presents figures on the number of children, and reasons for excluding them from the CAC and VAC groups.

Table 5.3 Children excluded from control groups in Study 2

Control group	Failure to match		Below 1SD of the mean		Other reasons	
	BD SS*	BPVS EA**	BD SS	BPVS SS ***	Pre-test	Other
Chronological age (CAC)	20		6	4	11	7
Vocabulary age (VAC)	6	52	1	10	11	10

BD SS = Block Design Standard Score; **BPVS EA** =British Picture Vocabulary Scale Equivalent Age; **BPVS SS**= British Picture Vocabulary Scale Standard Score

5.5.5 Children not included in control groups

As in the group of children with SLI, a large number of children with normal language development were seen initially but not included in the learning trials for various reasons. The loss of children from control groups also occurred in a study by Stark & Tallal (1981). Fifty percent of the normal children also did not meet their criteria for controls and were therefore excluded from the study. The most common reason was a speech articulation defect but a number of children had a history of hearing impairment, a mild language deficit or too high a performance IQ.

In addition, the process of identifying children for control groups individually matched to the children with SLI on various parameters requires far more children to be seen than are ever finally included. Furthermore, because identifying children with SLI for the study could not be completed before starting to identify controls, children who did not match any of the SLI children identified at that stage were excluded even though they might have matched a child with SLI identified at a later date.

5.6 Characteristics of subjects included in Study 2

Descriptive statistics for the three groups of children included in Study 2 are displayed in Table 5.4. The individual subject details for all three groups are presented in Appendix 17

Table 5.4 Characteristics of the Children in Study 2

	SLI n=16		**VAC** n=16		**CAC** n=16	
	Mean (Median)	**Range**	**Mean (Median)**	**Range**	**Mean (Median)**	**Range**
CA (months) at Study 2	83.94 (83.50)	65-108	52.75 (51.00)	45-68	83.62 (84.00)	64-108
BD SS	9.6 (10)	7-13	9.6 (10)	7-13	9.3 (9.5)	7-13
BPVS EA(months)	50.87 (50.50)	38-69	50.87 (50.50)	38-69	88.87 (84.00)	58-131
BPVS SS	71.13 (75)	50-83	99.62 (98)	86-116	104.87 (106)	88-124

CA= Chronological Age ; **BDSS** =Block Design Standard Score; **BPVS**= British Picture Vocabulary Scale (months)
EA= Equivalent Age; SS= Standard Score

From Table 5.4, it can be seen that the mean and median ages of the children with SLI and the age matched controls are very close, as are the mean and median standard scores for Block Design for all three groups, and the BPVS equivalent ages for the

SLI and vocabulary-age matched controls. This indicates that the groups were appropriately matched on the variables considered relevant to the study.

It is also important to demonstrate that the children with SLI have significant vocabulary deficits however and are significantly poorer than the normal controls. Both these criteria were met. The mean and median standard scores of the children with SLI fall more than 1.5 standard deviations below the test mean (and therefore in the impaired range) while the two control groups have standard scores within the normal range. However Stark & Tallal (1981) suggested that "if the proposed selection procedure was effective, then the verbal mental ages of the language impaired children should be consistently lower than those of the normal language children "(pp. 119-120). Therefore the mean and median scores of the three groups were compared to see if there was a statistically significant difference among them. A Kruskal Wallis one way analysis of variance showed that there was ($p<0.001$). In addition, pairwise comparisons showed that the SLI group had significantly lower standard scores on the BPVS than the vocabulary-age matched controls, (Mann Whitney-U, one tailed, $p<0.0001$), and the age matched controls (Mann Whitney-U, one tailed, $p<0.0001$).

5.7 Experimental procedure and materials

The stimuli for Study 2 have already been described in some detail in Chapter 3 but will be briefly described again. In addition, the procedure for the learning trials and any aspects of either the learning contexts or the word learning assessments not previously described will be outlined below. In particular, a description of the Word Recognition Test which was revised following Study 1 is provided in full.

Children were seen individually, in a separate room within the school or nursery, on four occasions over and above the pre-testing session. Occasionally a child was seen at home. Each session lasted between 20-30 minutes and consisted of the context for learning the experimental words (either the Story or the Explicit Teaching context) and five measures of word learning. In almost all cases children were seen on consecutive days in consecutive weeks. On the first day of the first week, half the children heard the experimental words (Set S) in the Story context, followed by the measures of word learning. The next day the same context and measures were repeated. A week later, the procedure was repeated using different experimental words (Set E) in the Explicit Teaching context. In the case of two control children however, illness during the learning trials meant either that the week and/or the days were not always consecutive.

The order in which the contexts was presented was counterbalanced across subjects (see section 5.7.4 and tables 5.5 and 5.6.)

5.7.1 The Story

After the materials had been piloted, 14 coloured illustrations were professionally drawn and spiral bound into a book with no text. For each of the four experimental words there were two pictures in which the item was depicted. The book was accompanied by the story on tape read by the experimenter. The full text of the story and the pictures are included as Appendix 12 . A part of the text for the experimental word *polka* was as follows:

Uncle Terry came round at 2 o'clock. " Get the music on!" he cried "I'll do a polka. " The music started and mum watched Uncle Terry do the polka. She thought it looked fun . "Come on," said Uncle Terry . "Get out of bed, it's your turn for the polka! "

Before she knew it, Uncle Terry had dragged mum out of bed to do the polka with him. Faster and faster they went. "Hey slow down, slow down," said mum, "I can't keep up". Just at that moment Uncle Terry stood on mum's toe with his big black boot. "Ouch, Ow, Oh no! That's enough of the polka " said mum. "You've hurt my toe. I'll need to get back into bed."

The children were told to listen to the story and encouraged to look at the book. It was suggested they listen until the story was finished and they were discouraged from interrupting. The experimenter turned the pages to coincide with the appropriate part of the tape.

5.7.2 The Explicit Teaching context

Stimuli for the explicit teaching context consisted of four professionally drawn laminated coloured pictures, 21 x 15 cm, one for each new word. The experimenter stated that she would tell the child about some pictures. The words were introduced in the same order for each child and the experimenter provided a set explanation for each picture e.g. for the word *kale* the child was told:

"Lets look at the kale now. OK this is kale. Kale is a kind of vegetable. Kale is a green vegetable. Can you see how green this kale is ? Right we've looked at the kale, let's do something else".

After the fourth picture and explanation had been presented, the examiner removed the pictures.

The pictures and text are included as Appendix 13.

5.7.3 Assessments of word learning

Following each learning context, the child was told that they would play some games. The five measures of word learning described below were then administered.

Naming

The child was asked to name each picture, pulled at random from a colourful bag. A score of 2 was awarded for each item which was 100% correct. Where there was an error but 50% or more of the sounds from the target word were present and in the correct order a score of 1 was awarded.

Word Recognition Test (revised)

Although the Word Recognition test was revised following Study 1, the basic task remained essentially the same. The child had to choose the correct pronunciation from a choice of four for each experimental word from either the Story or Explicit Teaching context.

The revised form of the test had eight items instead of four. The eight items (two for each word) were organised into two sections with each word assessed once in each section. There was a possible score of one point for each item.

One section of the test assessed storage of the nuclear vowel for each word. For example for the word *molasses*, the child was required to choose the correct pronunciation from /mʌlosɪz/, /mʌlesɪz/, /mɪʌlasɪz/, and mʌlisɪz/ spoken by the researcher. A correct choice suggested the child had stored the vowel correctly in his/her phonological representation. The other section assessed whether the child had stored the consonant following the nuclear vowel. For example for the word *molasses* the child was asked to choose between /mʌlasɪz/, /mʌladɪz/, /mʌlanɪz/, /mʌlakɪz/.

Distracters were constructed either by altering place and height in the case of the vowels, or by altering two distinctive features from a choice of place, manner or voicing, in the case of consonants. Distracter items were uniformly different from the target and were either nonsense or unusual real words. Sometimes however, a common real word resulted when distracters were constructed according to the above criteria. (This was not an appropriate distracter because the child might reject a common word on the basis of semantic knowledge.) Common words occurred when constructing the distracters for some items including the word "kale" because there were not enough vowels in English which fitted the criteria and produced nonsense or highly unfamiliar real words. It was therefore necessary to construct one of the distracters using the diphthong /ʌu/ which resulted in the infrequent real word "cowl".

Two versions of the test form were devised for each context. In one version the section of four items testing the nuclear vowel occurred first, followed by the section of four items testing the consonant after the nuclear vowel. In the other version of the form the order of the sections was reversed.

The experimental words were randomly ordered within each section of four. However the last item in the first section, and the first item in the second section did not test the same word. That is the same word could not be tested in two consecutive trials. This was because if the first trial tested the vowel, the consonant to be tested in the next trial would be consistently correct. This might prime the child to the correct response in the second of the two trials where the consonant was tested. The order in which the correct pronunciation of each experimental word occurred was also randomly determined.

As before the child was given a grid, (in the revised version, four boxes across by eight boxes down) and stickers. The instructions to the child were as follows:

> *"Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but one time I'll say the name just right. You have to put a sticker in one of the boxes for the time I said it just right. Let's practise first."*

There were four practice items for each test to ensure that the child could cope with the metalinguistic demands of the task. One of the test forms for each context and the grid appear in Appendix 11.

Word Description Test

In the Word Description test the children were asked to provide spoken definitions of the experimental words in random order.

A card with each experimental word written on it was placed face down on the table. The child was asked to point to a card. The researcher lifted the card and without showing the word to the child asked the following about the word which was written on the card e.g.

> *"Tell me all about the kale".*

If the child did not respond the tester asked:

> *"What is it?"*

If the child provided the category to which the item belonged the tester asked e.g.

> *"What kind of vegetable is it ?"*

If the child provided the attribute, the tester prompted the category label with a phrase using the attribute the child had said e.g:

"It's a green..........."

One point was awarded for the category and one point for the attribute giving a possible score of two for each item.

Meaning Recognition Test

The Meaning Recognition test was described in full in Chapter 3 section 3.2.2. However to briefly recap, following some practice questions there were 16 yes/no questions about the meanings of the experimental words from each context e.g. "Is a gauntlet long? Is a gauntlet a sock?"

Picture Comprehension

The Picture Comprehension test was described in Chapter 3 section 3.2.2. Essentially the child's task was to identify the correct picture of an experimental word from a choice of four on two different occasions. The distracter items were the other words from the same learning context. A total score of eight was possible.

5.7.4 Counterbalancing

Tables 5.5-5.6 display the order of presentation and the counterbalancing of contexts and measures for Study 2. There were two main aspects to the counterbalancing:

- The order in which the contexts containing the experimental words was presented i.e. whether the Story or Explicit Teaching context was presented first or second. Half the children started with the Story followed by the Explicit Teaching context and this order was reversed for the remaining children.

- The order in which the tests of word learning were presented i.e. whether the pairs of measures which differentially emphasise phonology or semantics (See Tables

5.5 and 5.6) were presented first or second. The Picture Comprehension test as an extra measure was however always last in the group of tests.

A less important aspect of the counterbalancing related to the version (V1) or (V2) of some of the tests. The versions only varied in the order of presentation of the test items/questions. However the different versions of the Word Recognition, Meaning Recognition and Picture Comprehension tests were also counterbalanced. (It was not necessary to have two versions of the Naming and Word Description tests since the child had to select an item on a card at random.)

An example of the counterbalancing for one child was as follows: A child given **Order A** heard the Story followed by the Naming test, the Word Recognition test, the Meaning Recognition test etc. (Time 1 assessments). The next day, the child heard the Story for the second time and was again tested on the measures of word learning (Time 2 assessments). The following week this child participated in the Explicit Teaching context followed by the measures of word learning on one day. The next day, the same context and measures were presented in exactly the same order.

In each group of 16 children, four received each permutation. Controls were given the same permutation as the child with SLI to whom they were matched.

Table 5.5 Counterbalancing and order of presentation for Study 2

ORDER A	**ORDER B**	**ORDER C**	**ORDER D**
STORY Time **1** Week **1**	**STORY** Time **1** Week **1**	**EXPLICIT TEACHING** Time **1** Week **1**	**EXPLICIT TEACHING** Time **1** Week 1
Naming	Word Description	Word Description	**Naming**
Word Recognition V 1	Meaning Recognition **V 2**	Meaning Recognition **V2**	**Word Recognition V1**
Word Description	**Naming**	**Naming**	Word Description
Meaning Recognition **V 1**	**Word Recognition V 2**	**Word Recognition V2**	Meaning Recognition **V1**
Picture Comprehension **V1**	Picture Comprehension **V2**	Picture Comprehension **V2**	Picture Comprehension **V1**
STORY Time **2** Week **1**	**STORY** Time **2** Week **1**	**EXPLICIT TEACHING** Time **2** Week **1**	**EXPLICIT TEACHING** Time **2** Week **1**
Naming	Word Description	Word Description	**Naming**
Word Recognition V2	Meaning Recognition **V1**	Meaning Recognition **V1**	**Word Recognition V2**
Word Description	**Naming**	**Naming**	Word Description
Meaning Recognition **V2**	**Word Recognition V1**	**Word Recognition V1**	Meaning Recognition **V2**
Picture Comprehension **V2**	Picture Comprehension **V1**	Picture Comprehension **V1**	Picture Comprehension **V2**

Table 5.5 (Cont) Counterbalancing and order of presentation for Study 2

ORDER A (cont)	ORDER B (cont)	ORDER C (cont)	ORDER D (cont)
EXPLICIT TEACHING Time 1 Week 2	**EXPLICIT TEACHING** Time 1 Week 2	**STORY** Time 1 Week 2	**STORY** Time 1 Week 2
Naming	Word Description	**Naming**	Word Description
Word Recognition V 1	Meaning Recognition **V2**	**Word Recognition V1**	Meaning Recognition **V2**
Word Description	**Naming**	Word Description	**Naming**
Meaning Recognition **V1**	**Word Recognition V 2**	Meaning Recognition **V1**	**Word Recognition V 2**
Picture Comprehension **V1**	Picture Comprehension **V2**	Picture Comprehension **V1**	Picture Comprehension **V2**
EXPLICIT TEACHING Time 2 Week 2	**EXPLICIT TEACHING** Time 2 Week 2	**STORY** Time 2 Week 2	**STORY** Time 2 Week 2
Naming	Word Description	**Naming**	Word Description
Word Recognition V 2	Meaning Recognition **V1**	**Word Recognition V2**	Meaning Recognition **V1**
Word Description	**Naming**	Word Description	**Naming**
Meaning Recognition **V 2**	**Word Recognition V1**	Meaning Recognition **V2**	**Word Recognition V1**
Picture Comprehension **V2**	Picture Comprehension **V1**	Picture Comprehension **V2**	Picture Comprehension **V1**

*** Assessments in bold differentially emphasise phonological learning**

5.8 Summary of Chapter 5 and link to Chapter 6

This chapter described the main aspects of the methodology for Study 2. Careful attention has been paid to selecting and matching the subjects included in Study 2. Furthermore considerable attention has been paid to developing an experimental paradigm which addresses many of the limitations of previous work on word learning in children with SLI. In Chapter 6 the results when children with SLI are compared with the two groups of controls on the various measures on word learning will be reported and discussed.

Firstly by comparing the scores for learning for each context separately at Time 1 and Time 2 separately (total word learning), conclusions will be drawn about the <u>extent</u> of the word learning difficulty in a group of children with SLI and a vocabulary deficit.

Secondly conclusions about the <u>nature</u> of any word learning difficulties will be drawn from comparisons between the groups on the measures which differentially emphasise phonological or semantic learning.

CHAPTER 6 RESULTS AND DISCUSSION OF A WORD LEARNING STUDY (STUDY 2)

6. Introduction

In this chapter the results from Study 2 will be presented and discussed. The specific questions addressed by the experimental investigation will be reiterated followed by data analysis. Finally there will be discussion of the results particularly in the light of past research.

Because the data were not normally distributed, non parametric statistical tests were used. When comparing the three groups, the Kruskal-Wallis One Way Analysis of Variance was used. If a significant difference was found among the three groups, pairwise comparisons were conducted using the Mann-Whitney U test. Where the difference between two groups was expected to be in one direction (e.g. that the children with SLI would perform more poorly than the age matched controls), a one tailed test was used. Where the direction of any effect was unknown, (e.g. the SLI group might perform better, the same as, or worse than the vocabulary-age matched controls) a two-tailed test was used.

Statistical analysis was carried out using the Minitab Release 11 (1996) and the SPSS programmes on a Personal Computer.

6.1 The <u>extent</u> of the word learning deficit

The first question asked whether or not children with vocabulary deficits had problems with word learning and, if so, how much poorer they were than their peers.

Four composite scores of Total Word Learning (TWL) (the sum of all five assessments from each context separately after Time 1 and Time 2 separately) were calculated. The groups were compared to determine whether children with SLI scored worse, the same or better than controls and whether any differences were statistically significant. It was also possible to determine the magnitude of any difference in learning between the groups to give an indication of the extent of any word learning difficulty in children with SLI.

Time 1

Figures 6.1-6.4 display boxplots for total word learning (TWL) in the three groups in both contexts at Time 1 and Time 2. The median TWL (indicated by the horizontal lines) is lower for the SLI group than for both control groups in all four boxplots.

Fig 6.1 Total Word Learning; Story context Time 1

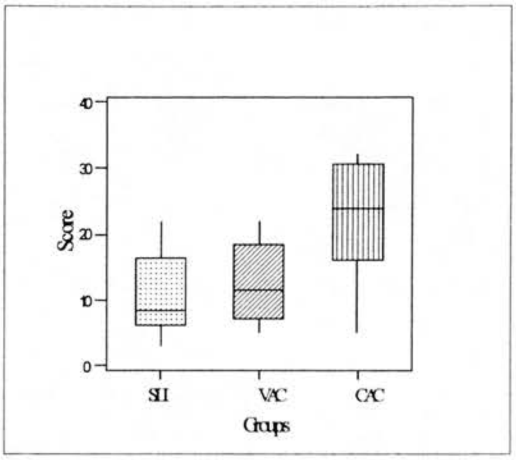


Fig 6.2 Total Word Learning; Explicit Teaching context Time 1

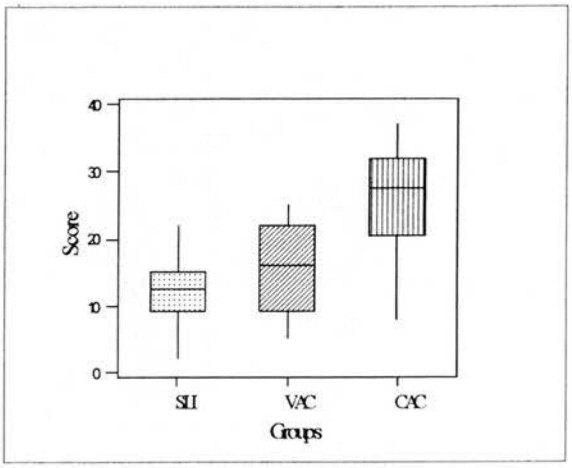


Fig 6.3 Total Word Learning: Story context Time 2

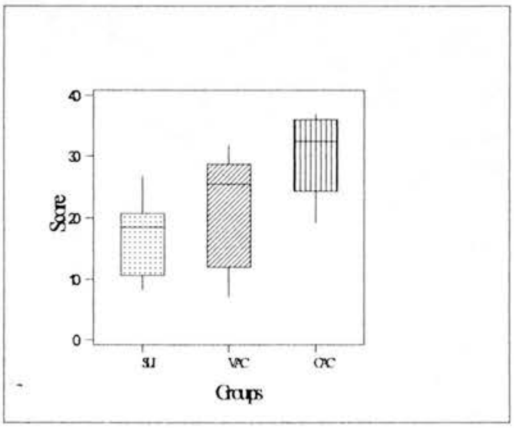
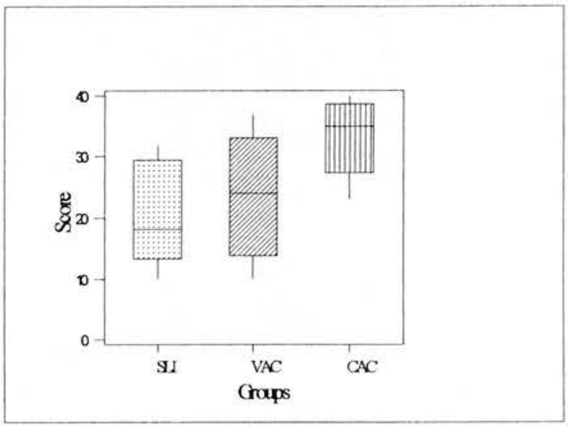


Fig 6.4 Total Word Learning: Explicit Teaching context Time 2



SLI =Specific language Impairment, VAC =Vocabulary-age controls, CAC =Chronological age controls

In Table 6.1 it can be seen that at Time 1, the children with SLI have a median score for TWL from the Story which is just over one third of the median in the CAC group and approximately 25% lower than the VAC group at Time 1. In the Explicit Teaching context, their TWL median score is slightly closer to the CAC group than in the Story but still substantially lower. The median score of the SLI group is also poorer than the VAC group on the Explicit Teaching context and the discrepancy between scores is roughly the same as for the Story.

The median score of the SLI group in both contexts at Time 2 is lower than the median score of both control groups and lower than the CAC group at Time 1. This suggests that even after the additional exposure to the words the SLI children were still not as good as their age matched peers had been after the initial learning opportunity.

Four Kruskal-Wallis One-way Analysis of Variance tests confirmed that the difference among the three groups for Total Word Learning was significant for words from both contexts at Time 1 and Time 2.

Table 6.1 Total Word Learning at Time 1 and Time 2 (Kruskal Wallis One-way Analysis of Variance)

		Story context			Explicit Teaching context		
Time 1		**SLI**	**VAC**	**CAC**	**SLI**	**VAC**	**CAC**
	Median	8.5	11.5	24	12.5	16	27.5
	Range	3-22	5-22	5-32	2-22	5-25	8-37
		df =2 H = 15.10 p=0.001 (adjusted for ties)			df=2 H=20.46 p=0.000 (adjusted for ties)		
Time 2							
	Median	18.5	25.5	32.5	18	24	35
	Range	8-27	7-32	19-37	10-32	10-37	23-40
		df=2 H=19.53 p=0.000 (adjusted for ties)			df=2 H=16.29 p=0.000 (adjusted for ties)		

SLI-Specific Language Impairment, VAC-Vocabulary-age matched controls CAC-Age-matched controls

Pairwise comparisons (Mann-Whitney-U one tailed) of data from the Story and the Explicit Teaching contexts at both Time 1 and Time 2 showed that the children with SLI had significantly poorer TWL than age matched controls, (**Time 1**; Story, W=171.5, p=0.0003, Explicit Teaching, W=156.0, p=0.0000, **Time 2** Story W=152, p=0.0000; Explicit Teaching, W=159.5 p=0.0000). The differences between the SLI and the VAC groups (Mann Whitney-U two-tailed) were not significant for either context at either Time 1 or Time 2.

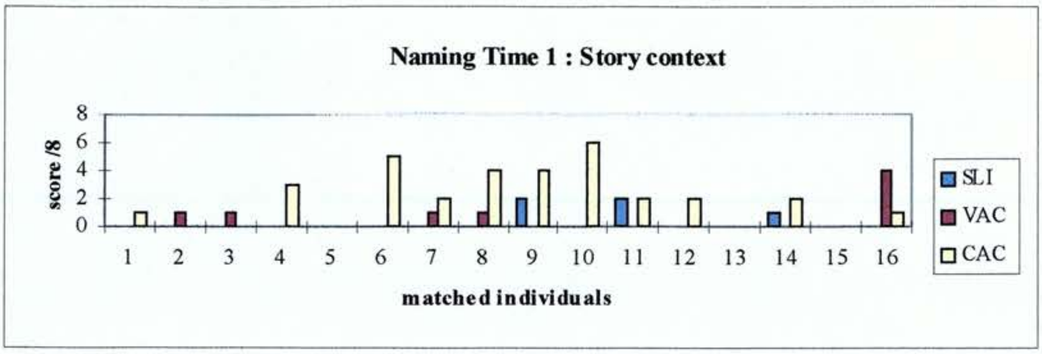
Thus the children with SLI learned significantly less about new words in both contexts at Time 1 and Time 2 than children the same age. Although their total word learning in both contexts at Time 1 and Time 2 was also poorer than the vocabulary-age matched children who were substantially younger, the differences were not significant.

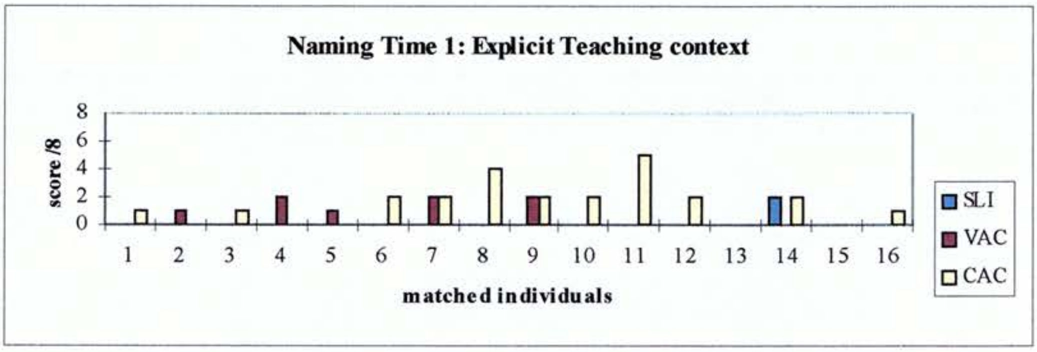
6.2 Approach to further data analysis

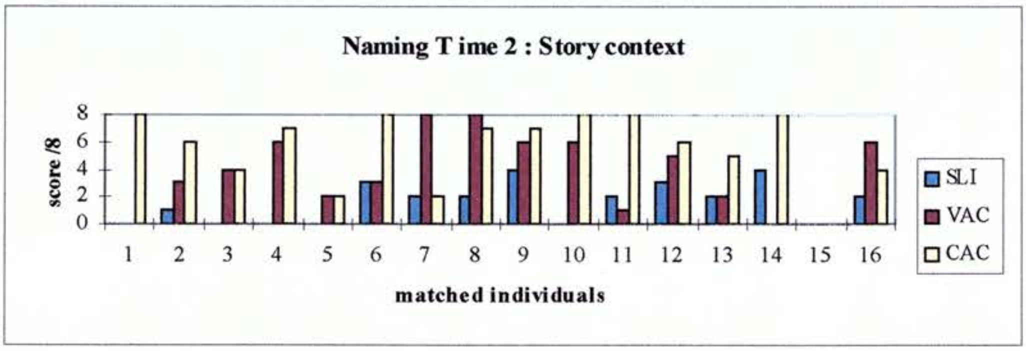
In the sections which follow the data from Study 2 will be considered in more detail. The main focus of the subsequent analyses will address questions about the nature of word learning deficits in children with SLI by comparing their performance with controls on individual assessments which differentially emphasise semantic or phonological learning. Prior to these however, preliminary appraisal of the data, displayed on twenty individual bar charts (one for each test from each learning context, at Time 1 and Time 2), was carried out to describe important characteristics. This appraisal resulted in some additional analyses over and above those originally planned. These are described in section 6.4 after the nature of the word learning difficulty in children with SLI has been considered.

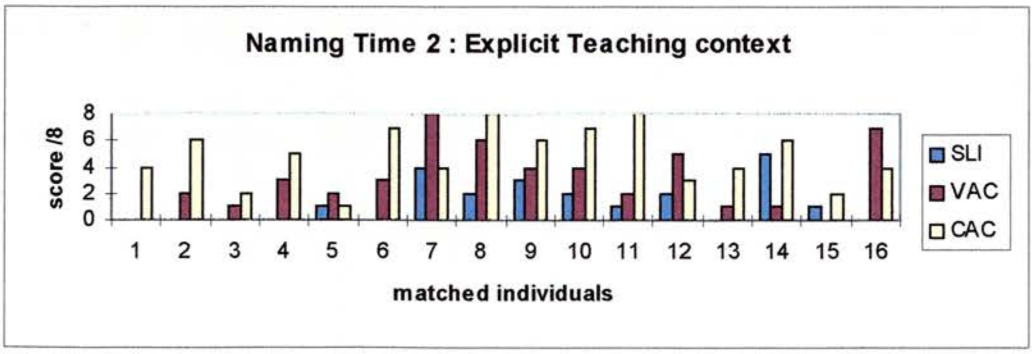
Figures 6.5-6.24 present twenty bar charts, one for each assessment task from each learning context at Time 1 and Time 2 separately. Each chart displays the score (out of eight) for a particular child with SLI alongside the individually matched control children.

Figs 6.5-6.8 Individual Data: Naming

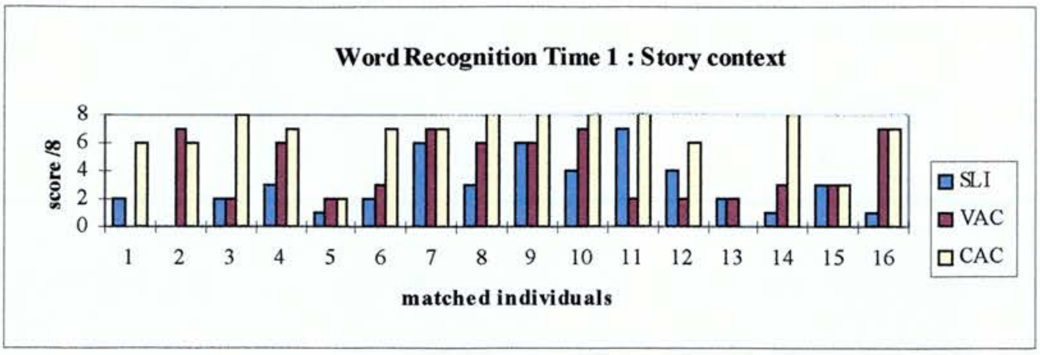


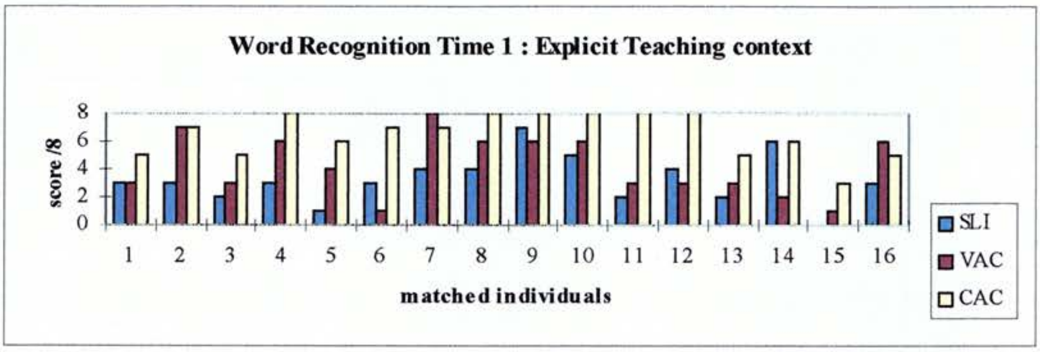


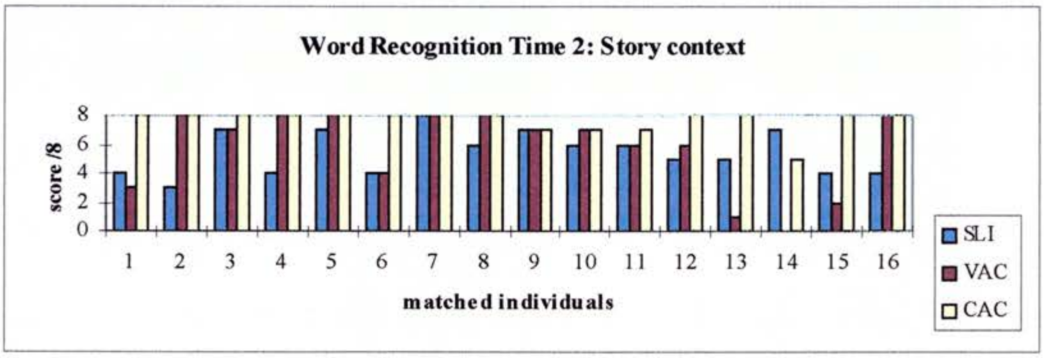


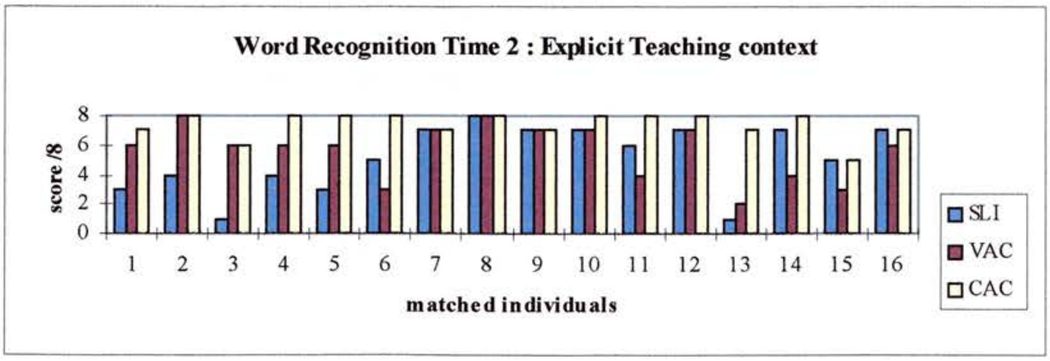


Figures 6.9-6.12 Individual Data :Word Recognition

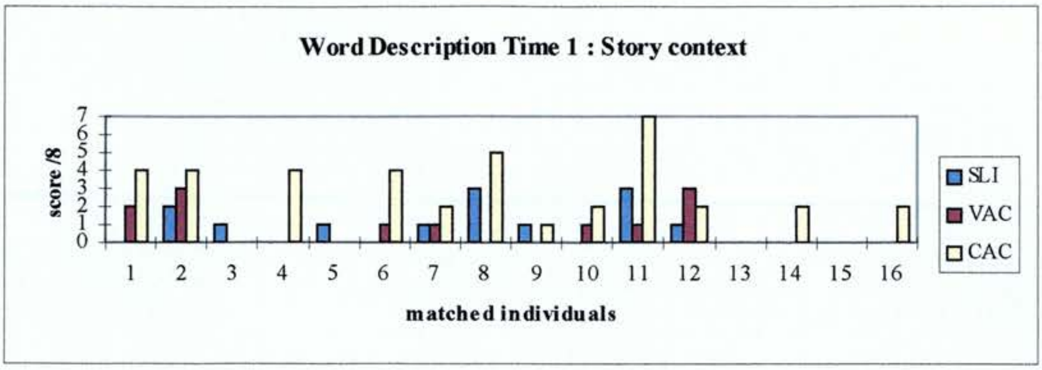


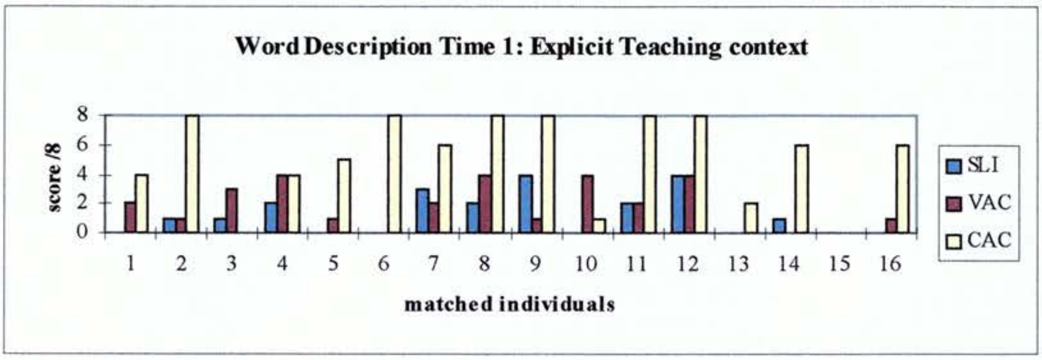


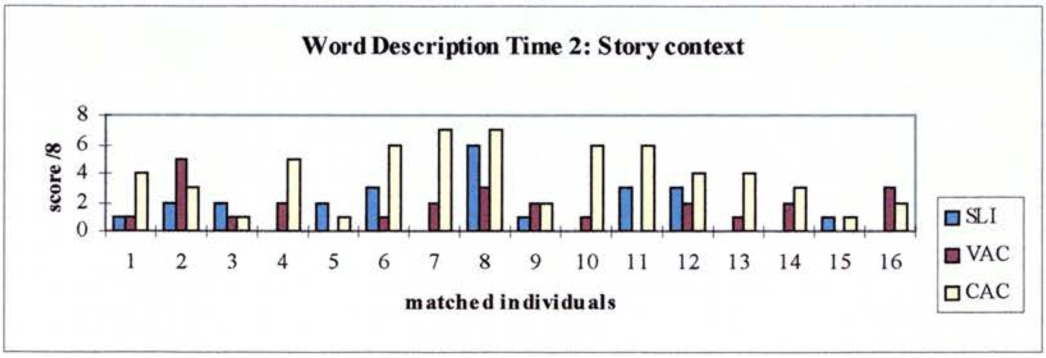


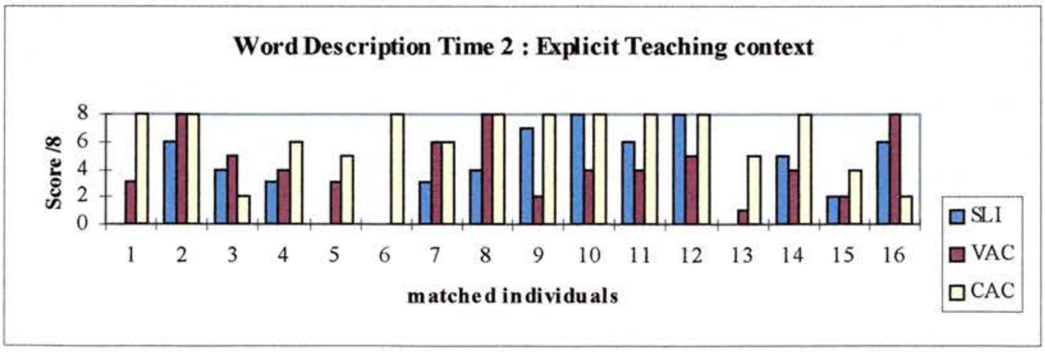


Figures 6.13-6.16 Individual Data: Word Description

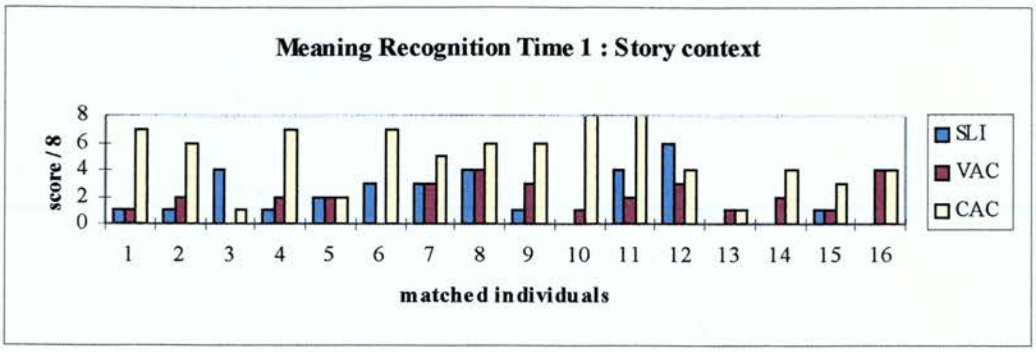


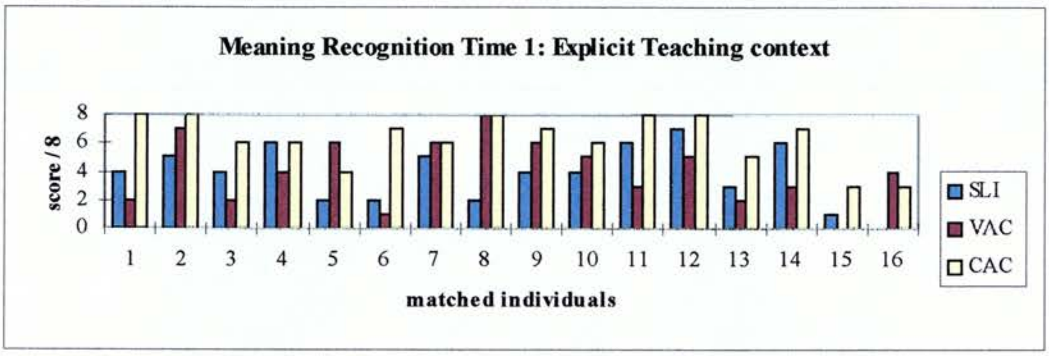


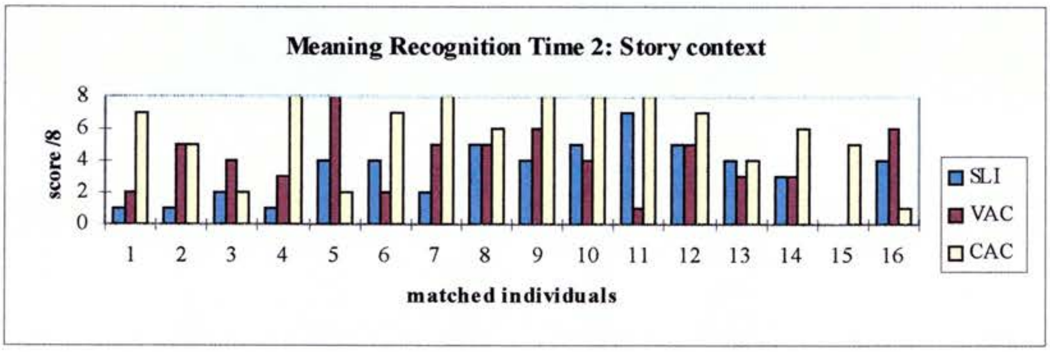


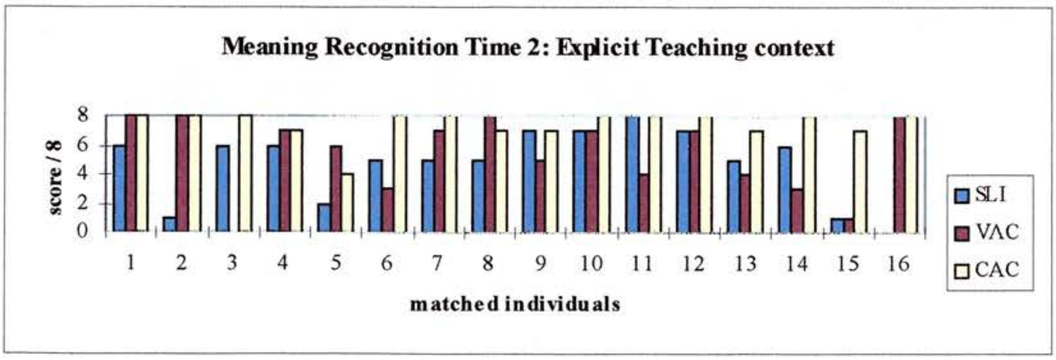


Figures 6.17-6.20 Individual Data: Meaning Recognition Test

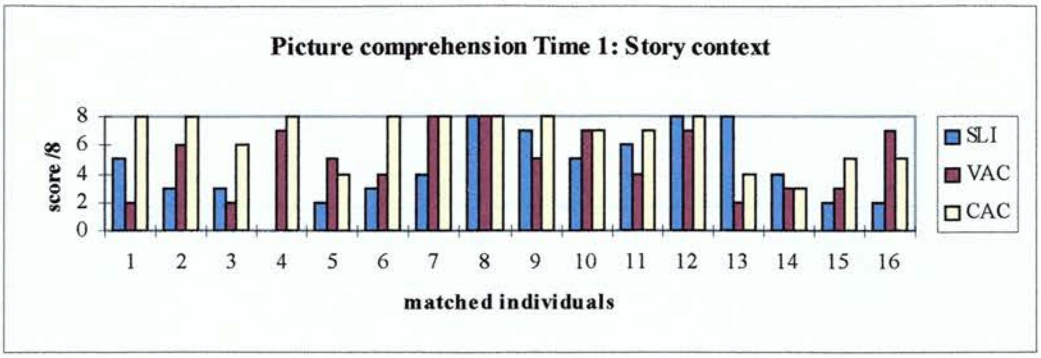


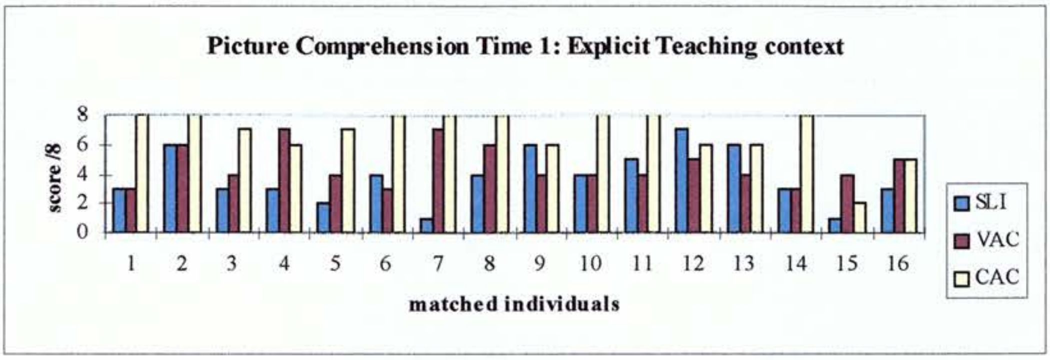


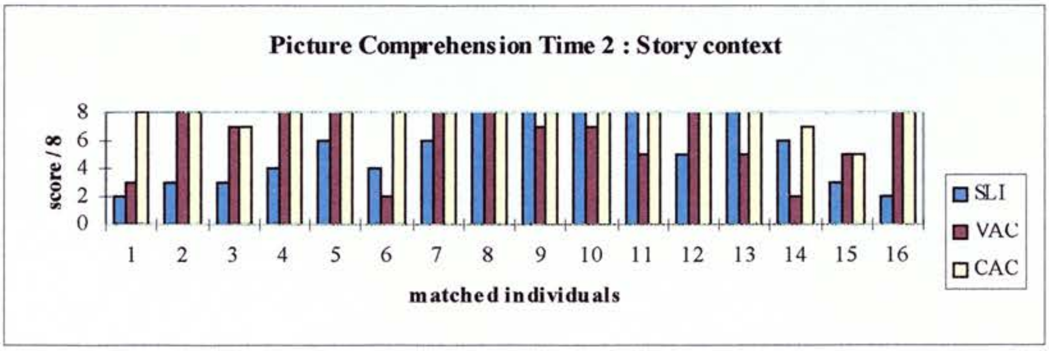


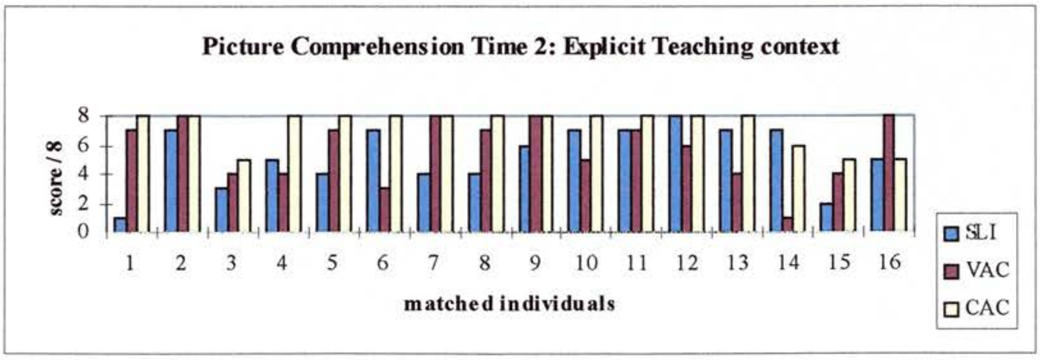


Figures 6.21-6.24 Individual Data: Picture Comprehension Test









Characteristics of the bar charts

- There is considerable variability in scores among children even in the same group. This is not surprising because although both the CAC and SLI groups had an average age of approximately seven years, the range was more than three and a half years. And even in the VAC group where there was less variation in the children's ages, there was still a range of almost two years.
- The majority of scores in the CAC group are superior to those of the children with SLI, irrespective of the assessment task. This suggests that the SLI group are poorer than children of the same age at both phonological and semantic learning.
- When individual children in the VAC and SLI groups are compared sometimes a child with SLI performs better than the child in the VAC group to whom he/she is matched. However on most assessment tasks there appear to be more children in the VAC group attaining higher scores than those in the SLI group. This is particularly evident on the naming tasks at Time 2 where the majority of children in the VAC group perform better than those with SLI.
- Floor effects (where children score very low or not at all) were apparent in all three groups on two of the word learning assessments from both contexts, Naming and Word Description. However these floor effects were most visible at Time 1 and more obviously in the SLI and VAC groups.
- Ceiling effects (where children score at, or close to, the maximum score) were also evident and occurred in all three groups. However these were most conspicuous in the CAC group and particularly on tasks where recognition (i.e. Word Recognition, Meaning Recognition and Picture Comprehension) rather than production (as in Naming and Word Description) was required. In addition ceiling effects generally increased at Time 2.
- Time 2 scores in all three groups were generally better than Time 1 scores. This suggests that the children benefited from the additional exposure given to the experimental words the second time each context was presented.
- There is an impression that the context in which the experimental words were presented affected performance. Children appeared to score more highly on Meaning Recognition and Word Description of words which were introduced in

the Explicit Teaching context and better on Picture Comprehension of words that were presented in the Story.

- The density of the graphs suggests that some assessments were easier than others. All three groups of children appear to score more highly on Word Recognition, Meaning Recognition and Picture Comprehension than they did on Naming and Word Descriptions.

A number of general features evident on these bar charts have been described above. However the focus of the subsequent analyses is on the nature of the word learning difficulties in children with SLI. Therefore this group will firstly be compared with controls on each of the assessment tasks, two of which differentially emphasise phonological learning and three of which emphasise semantic learning. Following the above preliminary appraisal of data presented on the bar charts some additional analyses were also considered appropriate. These included whether children in all three groups benefited significantly from extra exposure to the experimental words and whether the context in which the experimental words were presented significantly influenced performance. In section 6.3. the nature of word learning deficits will be addressed in detail. In section 6.4 the additional analyses on the effect of additional exposure and of context will be considered.

6.3 The nature of the word learning deficit

While it was important to confirm that children with SLI did indeed have word learning difficulties, this information is insufficient for planning intervention. Instead it is necessary to understand the nature of their word learning difficulty. The second research question in Study 2 particularly addressed this by asking ;

- What is the nature of word learning difficulties in children with SLI? Do they have problems with learning phonological information, with acquiring the meanings of new words or with both?

It will be recalled that in Study 2, word learning was assessed after each learning context, at Time 1 and Time 2, using five individual tasks. Two of these differentially emphasised phonology (Naming and Word Recognition), and three differentially emphasised semantics (Word Description, Meaning Recognition and Picture Comprehension). It was envisaged that when compared with controls, the performance of children with SLI on these tasks would provide insights into the nature of their word learning difficulty.

The three groups were compared on each individual assessment of word learning from each context at Times 1 and 2 separately. This entailed a total of 20 comparisons.

The data from the assessments of phonological and semantic learning were not normally distributed. Floor effects occurred on the Naming and Word Description measures particularly at Time 1. Ceiling effects were present on Word Recognition, Meaning Recognition and Picture Comprehension particularly at Time 2. These characteristics were referred to on page 128 and are apparent in figures 6.5-6.24. Non parametric tests, Kruskal-Wallis One-way Analysis of Variance and Mann Whitney-U tests were therefore used to establish whether differences between groups were statistically significant.

6.3.1 Phonological learning: Naming and Word Recognition

Table 6.2 presents descriptive and inferential statistics for the three groups on the Naming and Word Recognition assessments from both contexts at Time 1 and Time 2. The medians show that the children with SLI performed more poorly than the CAC group on all the assessments. The discrepancy between these groups was most evident at Time 2 on Naming and at Time 1 on Word Recognition. The latter observation may reflect ceiling effects in the CAC group which possibly obscured a greater difference at Time 2.

Children with SLI also had lower median scores than the VAC group on six of the eight assessments. The median scores of these groups were the same for naming words from both contexts at Time 1.

The Kruskal-Wallis test confirmed a significant difference among the three groups on Naming and Word Recognition assessments from both contexts and at both Time 1 and Time 2.

Table 6.2 A Comparison of Phonological Learning in Children with SLI, Vocabulary-age and Chronological-age matched controls using Kruskal-Wallis One-way Analysis of Variance

	SLI	**VAC**	**CAC**	**df**	**H**	**p =**
Naming	Median (Range)	Median (Range)	Median (Range)			
Story T1	0.0 (0-2)	0.0 (0-4)	2.0 (0-6)	2	11.51	0.003*
Story T2	2.0 (0-4)	3.5 (0-8)	6.5 (0-8)	2	15.76	0.000*
Ex Teach T1	0.0 (0-2)	0.0 (0-2)	1.5 (0-5)	2	13.59	0.001*
Ex Teach T2	1.0 (0-5)	2.5 (0-8)	4.5 (1-8)	2	16.44	0.000*
Word Recognition						
Story T1	2.5 (0-7)	3.0 (0-7)	7.0 (0-8)	2	13.15	0.001*
Story T2	5.5 (3-8)	7.0 (0-8)	8.0 (5-8)	2	15.20	0.000*
Ex Teach T1	3.0 (0-7)	3.5 (1-8)	7.0 (3-8)	2	16.98	0.000*
Ex Teach T2	5.5 (1-8)	6.0 (2-8)	8.0 (5-8)	2	14.12	0.001*

* adjusted for ties

SLI=Specific Language Impairment, VAC=Vocabulary-age controls, CAC=Chronological-age matched controls

Planned pairwise comparisons between the SLI and CAC groups (Mann Whitney-U test, one tailed) and between the SLI and VAC groups (Mann Whitney-U test, two-tailed) were carried out to establish where significant differences on the phonological learning measures occurred. Results were as follows:

<u>Naming</u>

The SLI group was significantly poorer than the CAC group when asked to name pictures of the experimental words from both contexts at Time 1 and Time 2, viz. **Story Time 1** (W=192.5, p=0.0015) **Explicit Teaching Time 1** (W=184.5, p=0.0003), **Story Time 2** (W=164.0, p=0.0001), **Explicit Teaching Time 2** (W=161.5, p=0.0001).

The difference in Naming between the SLI and VAC groups was not significant at Time 1 in either context although there was a trend for the VAC group to perform better in the Explicit Teaching context (W=233.0, p=0.09). At Time 2, the SLI group was significantly poorer on the naming assessments from both contexts viz. **Story** (W=204.5, p=0.023), **Explicit Teaching** (W=205.5, p=0.026)

Word Recognition

The SLI group was also significantly poorer than the CAC group when asked to select the correct pronunciation of the experimental words from a choice of four, viz. **Story Time 1** (W=176.0, p=0.0004), **Explicit Teaching Time 1** (W=159.0, p=0.0000), **Story Time 2** (W=160.5, p=0.0000), **Explicit Teaching Time 2** (W=177.0, p=0.0004). The differences between the SLI and the VAC groups were not significant for words in either context at Time 1 or Time 2.

6.3.2 Semantic learning: Word Description, Meaning Recognition and Picture Comprehension

Statistics for all the three assessments which differentially emphasised semantics viz. Word Description, Meaning Recognition and Picture Comprehension are displayed on Table 6.3. The median scores of children with SLI are poorer than those of the CAC group on all three assessments of the words from the Story and the Explicit Teaching context at both Time 1 and Time 2.

When the median scores of the SLI and VAC groups were compared, those of the SLI group were lower than, or the same as, these younger controls except on Word Description (Story Time 1) where the SLI group had a median score 0.5 higher than the VAC group.

The Kruskal Wallis One Way analysis of Variance indicated that there was a statistically significant difference among the three groups for each assessment of semantic learning from both contexts at Time 1 and Time 2.

Table 6.3 A Comparison of semantic learning in children with SLI, age matched and vocabulary age matched controls using Kruskal-Wallis One-way Analysis of Variance

	SLI	VAC	CAC	df	H	p=
Word Description						
	Median (Range)	Median (Range)	Median (Range)			
Story T1	0.5 (0-3)	0.0 (0-3)	2.0 (0-7)	2	8.52	0.014*
Story T2	1.0 (0-6)	1.5 (0-5)	4.0 (1-7)	2	13.01	0.001*
Ex Teach T1	1.0 (0-4)	2.0 (0-4)	6.0 (0-8)	2	14.76	0.001*
Ex Teach T2	4.0 (0-8)	4.0 (0-8)	8.0 (2-8)	2	8.34	0.015*
Meaning Recognition						
Story T1	1.0 (0-6)	2.0 (0-4)	5.5 (1-8)	2	15.49	0.000*
Story T2	4.0 (0-7)	4.0 (0-8)	6.5 (1-8)	2	9.88	0.007*
Ex Teach T1	4.0 (0-7)	4.0 (0-8)	6.5 (3-8)	2	11.86	0.003*
Ex Teach T2	5.5 (0-8)	6.5 (0-8)	8.0 (4-8)	2	14.75	0.001*
Picture Comprehension						
Story T1	4.0 (0-8)	5.0 (2-8)	7.5 (3-8)	2	7.82	0.02*
Story T2	5.5 (2-8)	7.0 (2-8)	8.0 (5-8)	2	10.73	0.005*
Ex Teach T1	3.5 (1-7)	4.0 (3-7)	7.5 (2-8)	2	19.11	0.000*
Ex Teach T2	5.5 (1-8)	6.5 (1-8)	8.0 (5-8)	2	12.69	0.002*

*adjusted for ties

SLI=Specific Language Impairment, VAC=Vocabulary-age controls, CAC=Chronological-age matched controls

Planned pairwise comparisons between the SLI and CAC groups (Mann Whitney-U test, one tailed) and between the SLI and VAC groups (Mann Whitney-U test, two-tailed) were carried out to establish where significant differences occurred. Results were as follows:

Word Description

Children in the SLI group were significantly poorer than those in the CAC group at giving definitions of words from the **Story, Time 1** (W=202.0, p=0.008), the **Explicit**

Teaching, Time 1 (W=175.0, p=0.0003), **Story, Time 2** (W=181.5, p=0.0009), **Explicit Teaching, Time 2** (W=198.0, p=0.0057).

The difference between the SLI and VAC groups was not significant at either Time 1 or Time 2.

Meaning Recognition

Children with SLI were also significantly poorer than the age matched controls (CAC group) at responding to 'yes/no' questions about the meanings of the experimental words from both contexts at Time 1 and Time 2 viz. **Story, Time 1**, (W=176.5, p=0.0005), **Explicit Teaching, Time 1**, (W=181.5, p=0.0009), **Story, Time 2**, (W=186.5, p=0.0017) **Explicit Teaching, Time 2**, (W=165.5, p=0.0001).

The SLI and VAC groups were not significantly different on any of the Meaning Recognition assessments.

Picture Comprehension

The SLI group was again significantly poorer than the CAC group when asked to select pictures of the experimental words from both learning contexts after Time 1 and Time 2 viz. **Story, Time 1** (W=198.0, p=0.0057) **Explicit Teaching, Time 1** (W=165.0, p=0.0001), **Story, Time 2** (W=187.0, p=0.0007), **Explicit Teaching, Time 2** (W=176.5, p=0.0003) .

There were no statistically significant differences between the SLI group and the much younger vocabulary age matched controls.

6.3.3 Additional analysis of Word Description

While scoring the responses for Word Description, it was noted that many children provided related information which, using the predetermined scoring system, was not credited with any points. It was hypothesised that the scoring system may have obscured similarities or differences between the groups. It was particularly interesting to see whether children with SLI and their vocabulary-age matched controls differed when these additional responses were considered.

The data were therefore re-examined and all responses relevant to the target words (i.e. with some element of correctness) over and above those already scored were identified. These responses were categorised as follows:

- **Context Associated Information (CAI)** These were responses which came from the specific linguistic context for the target word. Although the information was associated with the target word, such information might not form part of an acceptable definition for the word. For example for *molasses* the responses "you put it on crispies", or "it's in a can or a tin" were scored as context associated information. This category only occurred for the Story words. It was counted even if children had already provided one or both aspects of the required definition in their Word Description response.

- **Mapping Close (MACLO)** Responses of this type defined the item as something it was not, but as something which had been derived from the context in which the word occurred. Although MACLO had similarities with CAI above, in this category children actually used another word for the target. Examples included children who said *a phial was medicine* or that *a polka was a dancer*. This type of response also only occurred for the Story words.

- **Visual Information Recalled (VIR)** This category was used for responses where a child described the word using the name of an item with definite visual similarities to the target word e.g. *seagull* for *albatross*, or where additional visual information associated with the picture was recalled e.g. *it has a clip on its arm*, for *gauntlet*. It included appropriate mime and gesture. VIR responses occurred in both contexts.

Children's answers on the Word Description task were coded according to the above categories. Only one occurrence in each category was allowed per response. Responses in which the additional information such as "it flies" was already implicit in a previously scored response e.g. "it's a bird" were not coded.

Additional Responses from the Explicit Teaching Context

The additional responses for Word Description from the Explicit Teaching context at Time 1 and Time 2 separately are displayed in Table 6.4

Table 6.4. Additional responses on Word Description (Explicit Teaching context)

	Time 1			**Time 2**		
Group	**SLI**	**VAC**	**CAC**	**SLI**	**VAC**	**CAC**
Visual Information Recalled (No of responses)	4	4	15	11	4	14

At Time 1, the CAC group recalled far more visual information than either the SLI or VAC groups who had the same number of VIR responses as each other. Interestingly at Time 2, the VAC group still produced the same number of these responses but the children with SLI were producing almost as many VIR responses as the CAC group. The association between the SLI and the CAC group in the number of VIR responses at Time 1, and between the SLI and VAC, and the SLI and CAC groups and the number of VIR responses at Time 2 was tested using one-dimensional Chi-Square tests. The tests revealed that the CAC group was associated with significantly more VIR responses than the SLI group at Time 1 (Chi-Square=6.368, df=1, p=0.012) but not at Time 2. There was a trend for the SLI group to be associated with more VIR responses than the VAC group at Time 2 (Chi-Square=3.267, df=1, p=0.071).

Additional Responses from the Story Context

The additional responses for Word Description from the Story context appear in Table 6.5.

Table 6.5 Additional responses for Word Description (Story context)

	Time 1			Time 2		
	SLI	**VAC**	**CAC**	**SLI**	**VAC**	**CAC**
CAI	11	12	19	16	28	33
MACLO	7	7	7	12	13	8
VIR	4	4	13	7	5	16

VIR=Visual Information Recalled, **MACLO**=Mapping Close **CAI**=Context Associated Information

The SLI and VAC groups produced a similar number of Context Associated Information responses at Time 1 while the CAC group produced a larger number. At Time 2 the VAC and CAC groups were both producing many more CAI responses than the SLI group, suggesting that they had remembered more information from the context in which the word occurred. The one dimensional Chi-Square test was again used to establish whether there was a significant relationship between a particular group and the number of CAI responses. This showed that the CAC group was associated with significantly more CAI responses than the SLI group at Time 2 (Chi-Square=5.898, df=1, $p<0.05$) but not at Time 1. There was also a trend (Chi-square=3.273, df=1, $p= 0.07$) for the VAC to be associated with more CAI responses than the SLI group at Time 2.

The total number of responses in the MACLO category was the same for all three groups at Time 1. At Time 2 however this was the only category where the CAC group made fewer responses than the other two groups. Taken together with the CAC group's improved score on Word Description at Time 2, this may indicate that they were producing more precise answers when asked to describe the experimental words. Consequently the number of MACLO responses decreased.

There were no significant relationships between any of the groups and the number of MACLO responses using the one-dimensional Chi-Square test.

As in the Explicit Teaching context, the CAC children produced considerably more responses in the category VIR than the SLI and VAC group at Time 1. However the number of these responses in the SLI group at Time 2 did not approximate the total in the CAC group, as it had done in the Explicit Teaching context at Time 2. This may suggest that the SLI children did not pick up this type of information unless the words are specifically drawn to their attention.

A one-dimensional Chi-Square indicated that the CAC group was associated with significantly more VIR responses than the SLI group at Time 1 (Chi-Square=4.765, df=1, $p<0.05$) and at Time 2 this relationship approached significance (Chi-Square=3.522, df=1, $p=0.061$). There was no association between the number of VIR responses when the VAC and SLI groups were compared.

A summary of the results from the analyses of additional responses on the Word Description assessment is as follows:

- Visual Information Recalled (VIR)

The results suggested that the SLI children were generally similar to younger controls and that they usually, though not always, recalled less visual information about the experimental words than children of the same age. However the relatively strong performance of the SLI group at Time 2 on words from the Explicit Teaching context suggests that they may, given enough exposure and a salient enough referent, store as much information about a new word from its picture as age matched controls.

- Context Associated Information (CAI)

In contrast to some strength in the recall of visual information, the SLI group seemed less able to recall information from the surrounding linguistic context for the target words in the Story. This was apparent at Time 2 when the CAC group was significantly associated with higher numbers of CAI responses than the SLI group and where there was a trend for the VAC group to be also associated with more CAI responses than the children with SLI.

Mapping Close (MACLO)

There were no significant associations between any of the groups and the number of MACLO responses although it was interesting that this was the only category of response where the CAC group made less responses than the SLI and VAC groups. However, whereas in the other categories, the responses provide information which is not incorrect but just not part of an acceptable definition for the experimental word, MACLO responses are incorrect (albeit with some relationship to the target word). Therefore the lower score in the CAC group may in fact indicate that they were making fewer errors.

6.3.4 Within group comparisons of Word Description and Naming

In the previous sections, performance on each individual measure of word learning was compared between the groups of children. From these analyses the notion that phonological learning may be even more problematic than semantic learning emerged. There is also further evidence for this idea if some measures are compared within the groups.

Within group comparisons were made using the Word Description and Naming measures from each context at Time 1 and Time 2. It will be recalled that these assessments both require the children to produce rather than merely recognise the correct response. However they differ in that they were designed to distinguish between semantic and phonological learning respectively. It was therefore interesting to explore whether patterns within each group of children were similar.

Within each group, children's scores for Naming were subtracted from their scores for Word Description. A positive score indicated that a child was better at Word Description than Naming while a negative score suggested the reverse was true. Within group comparisons were made on the resulting scores from each context at Times 1 and 2 separately using the Wilcoxon Signed Ranks Test.

Table 6.6 Within group comparisons; (Word Description-Naming)

	Story context			Explicit Teaching context		
Time 1	# Median	Wilcoxon Statistic	p=	Median	Wilcoxon Statistic	p=
SLI	0	37	0.097	0.5	43	0.018
VAC	0	30	0.407	1	53	0.011
CAC	0	29.5	0.441	4	117	0.001
Time 2						
SLI	0	35.5	0.814	2.5	74	0.007
VAC	-2.5	13	0.008	1	59	0.364
CAC	-2.0	16	0.013	1.5	83.5	0.009

A negative median indicates a better performance on Naming. A positive median suggests a better performance on Word Description.

The positive medians at Time 1 displayed in Table 6.6, show that all three groups were better at Word Description in the Explicit Teaching context at Time 1. These differences between the assessments were significant for the words from the Explicit Teaching context. This suggests that all three groups had learned more semantic than phonological information about the words from the Explicit Teaching context.

At Time 2, in the Explicit Teaching context a similar pattern emerged. All three groups (as apparent from the positive median difference) had better scores on Word Description than on Naming although the difference is only significant in the SLI and CAC groups and not in the VAC controls.

In the Story however, a different and rather interesting pattern emerged. At Time 2 both control groups (as apparent from the negative medians) perform significantly better on Naming than they did on Word Description but there was no significant difference between these two measures in the SLI group. This different pattern in the SLI group again emphasises the particular problems they seem to have on measures which differentially emphasise phonology.

6.3.5 Summary of results regarding the nature of word learning difficulties in children with SLI.

Analysis of the five individual assessments of word-learning, two which differentially emphasised phonological information and three which differentially emphasised semantic information in each context at Time 1 and Time 2, showed that the SLI group had more difficulty than children of the same age and non verbal intelligence in learning semantic and phonological information for new words. Their learning deficit was apparent both in different contexts and after initial and additional opportunities to learn the words. This suggests that as a group they appear to have rather global and complex word learning difficulties.

The children with SLI were similar to the vocabulary-age matched controls on most measures but they were significantly poorer at naming pictures of items from both contexts at Time 2. These results suggest that their ability to learn semantic information is only as good as a group of children who are on average two and a half years younger. They appear to have an even poorer ability to learn the phonological information required for naming.

Overall the results indicate problems in all aspects of word learning and may suggest particularly poor acquisition of phonological information.

6.4 Additional analyses of the data from Study 2

On page 128 a variety of characteristics of the data from Study 2 were identified. Following this, data analyses concentrated on identifying the nature of the difficulty in children with SLI and specifically focused on whether phonological or semantic learning was impaired. However the bar charts presented in section 6.2 also highlighted two other main characteristics of the data in all three groups of children which became apparent because of the methodology employed in Study 2.

Firstly it will be recalled that word learning was assessed after initial exposure to the experimental words and then again after the second learning opportunity for each context. This resulted in Time 1 and Time 2 scores for each child. (Assessments at Time 1 and Time 2 were included as an aspect of the methodology designed to help offset the possible floor effects in the VAC group at Time 1, and the possible ceiling effects of the CAC group at Time 2.)

When the bar charts were inspected in section 6.2, it was apparent that all three groups of children had higher scores for word learning at Time 2 compared with Time 1. It was therefore decided to analyse whether the apparent gain in scores at Time 2 was significant, and if so, whether children with SLI benefited from the extra exposure to the experimental words as much as children in the control groups.

Study 2 also assessed word learning following two quite different contexts for learning and there was an impression from the bar charts that children in all three groups scored more highly on Meaning Recognition and Word Description of words which were introduced in the Explicit Teaching context and better on Picture Comprehension of words that were presented in the Story. In relation to this it was decided to consider whether context significantly affected children's learning of semantic and phonological information. If so, it was also of interest to see whether word learning in children with SLI was affected by context to the same extent as the control groups.

The following additional research questions were therefore posed:

1. Do children in all three groups score significantly better on assessments of word learning at Time 2 compared with Time 1? (in other words, do children benefit significantly from extra repetition of the experimental words?)

2. Do children with SLI benefit from the extra exposure to the experimental words as much as children in the control groups?

3. Do children in all three groups score significantly better on assessments of word learning in either of the two contexts?

4. Is word learning in children with SLI affected by context to the same extent as for children in the control groups.

Questions 1 and 3 were addressed by making comparisons within each group of children. Questions 2 and 4 were addressed by between group comparisons.

6.4.1 Gain in word learning from extra exposure to 'new' words

Questions 1 and 2 relating to gain are addressed in the tables, scatterplots and statistical analyses which follow.

6.4.1.1 Is there a gain?

Table 6.7 shows the number of children out of 16 in each group who improve their score at Time 2 (**T2>T1**), the number of children whose score stays the same **(T1=T2),** and the number whose score is lower at Time 2 than it was at Time 1 **(T2<T1).**

Table 6.7 Patterns of performance on assessments from the Story and Explicit Teaching contexts (Children /16)

	T2 >T1			T2 =T1			T2 <T1		
Story	**SLI**	**VAC**	**CAC**	**SLI**	**VAC**	**CAC**	**SLI**	**VAC**	**CAC**
Naming	9	13	14	7	3	2	0	0	0
Word Recognition	15	12	10	0	1	2	1	3	4
Word Description	7	9	12	8	4	3	1	3	1
Meaning Recognition	9	14	8	3	0	6	4	2	2
Picture Comprehension	9	11	7	5	3	9	2	2	0
Explicit Teaching									
Naming	9	14	16	7	2	0	0	0	0
Word Recognition	12	12	9	2	2	6	2	2	1
Word Description	11	13	7	5	3	8	0	0	1
Meaning Recognition	8	11	9	7	3	6	1	2	1
Picture Comprehension	12	10	6	3	4	8	1	2	2

SLI=Specific Language Impairment, VAC=vocabulary-age controls, CAC=chronological age controls

T2>T1

Table 6.7 shows that on almost every assessment from the Story and the Explicit Teaching contexts, eight or more children in each of the three groups scored higher at Time 2 than they had at Time 1. Exceptions on assessments following the Story were, Word Description where only 7/16 children with SLI improved on their Time 1 score and Picture Comprehension where only 7/16 of the CAC group had a higher score at Time 2 than they had at Time 1. Exceptions following the Explicit Teaching context only occurred in the CAC group, where on Word Description only 7/16 improved their score at Time 2 and on Picture Comprehension 6/16 had a higher score at Time 2.

T1=T2

Numbers of children in this category represent those whose score did not increase following the additional exposure given to the words at Time 2. It can be seen that there were children in all three groups who came into this category, but that overall there were more children in this category from the SLI and CAC groups.

T2<T1

There were children in all three groups who performed more poorly at Time 2 than they had at Time 1. However the numbers of children falling into this category were generally smaller than the numbers falling into the other two categories, (viz T2>T1 and T1=T2). The T2<T1 pattern was observed on all the measures except Naming and most frequently on measures which were multiple choice, although they did also occur to some extent on the Word Description test which was not. Although a drop in scores may reflect poor retention of information previously acquired, the multiple choice format of three tests (Word Recognition, Meaning Recognition and Picture Comprehension) may have allowed children to score better at Time 1 than Time 2 simply by chance.

Scatterplots (figures 6.25-6.34) for each word learning assessment are also presented. On each one, Time 1 scores for each individual child are plotted against their Time 2 scores for each context separately. Points falling above the diagonal line indicate those children whose scores are better at Time 2 than Time 1. Scores on, or very close to the line, indicate no change between Time 1 and Time 2. Scores falling below the line show children whose scores at Time 2 were worse than those at Time 1. Scores occurring up the left hand Y axis indicate floor effects at Time 1, e.g. figure 6.30 Gain in Naming: Explicit Teaching context. Scores along the top X axis indicate ceiling effects at Time 2, e.g. figure 6.32 Gain in Word Description: Explicit Teaching context. Clusters of scores in the bottom left hand corner of a plot indicate children whose T1 and Time 2 scores are very low e.g. figure 6.27 Gain in Word Description: Story context while those in the top right hand corner indicate those whose T1 and T2 scores were very high e.g. figure 6.33 Gain in Meaning Recognition: Explicit Teaching context.

In this way the scatterplots enable us to see more detailed characteristics of the data than is evident in the tables. In particular they allow us to identify different reasons for no gain in scores (i.e. T1=T2). In the CAC group this was often because a number of children scored the maximum number of points at Time 1. This meant that there was no 'room for improvement' at Time 2. In most cases in the SLI and VAC groups, when children scored the same at Time 2 as they had at Time 1, this reflected a lack of improvement. A clear example of this difference in pattern occurs in figure 6.32 Gain in Word Description: Explicit Teaching context where six of the eight children in the CAC whose T1 score equalled their T2 score had scored the maximum at Time 1 and therefore could not demonstrate any improvement in learning on their Time 2 score. Their data points are located at the extreme right hand corner of the plot. In contrast the five children with SLI whose T1 score equalled their T2 score were mainly represented on the opposite corner of the graph because four of them scored zero on both occasions.

Figure 6.25 Gain in Naming : Story Context

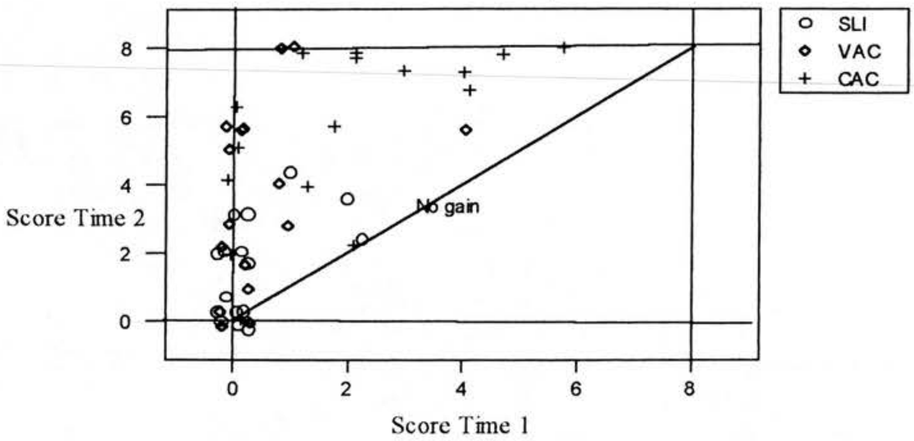


Figure 6.26 Gain in Word Recognition : Story Context

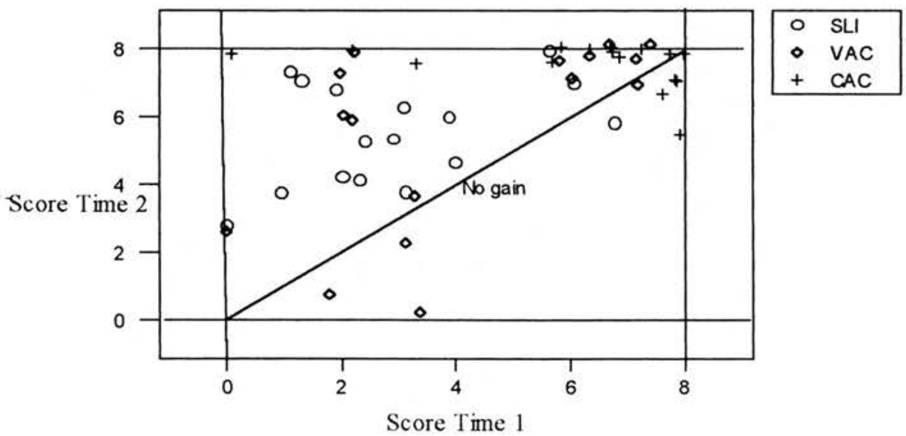


Figure 6.27 Gain in Word Description : Story Context

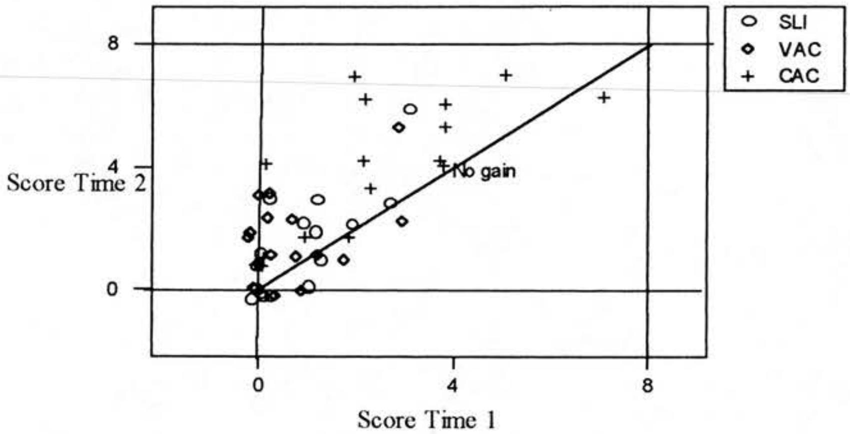


Figure 6.28 Gain in Meaning Recognition : Story Context

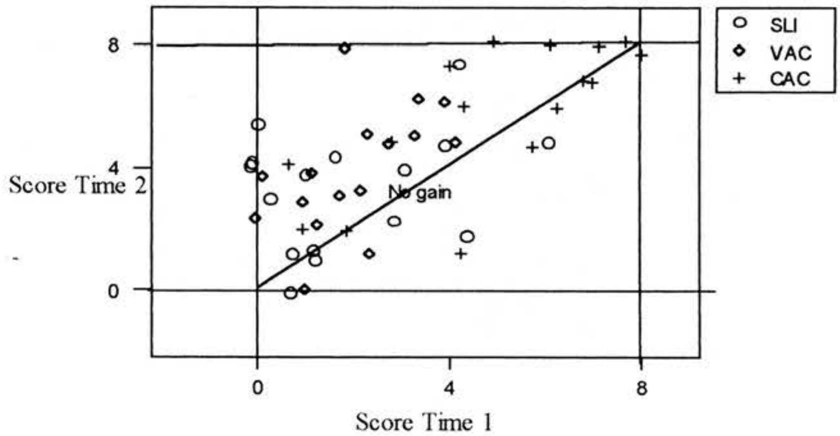


Figure 6.29 Gain in Picture Comprehension : Story Context

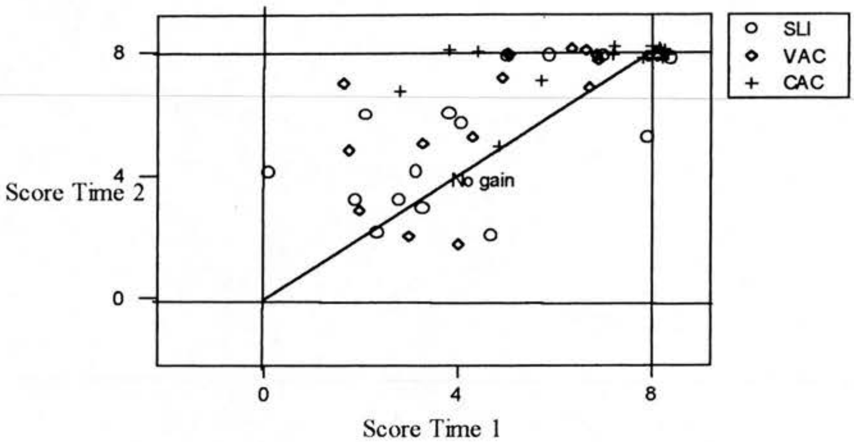


Figure 6.30 Gain in Naming : Explicit Teaching Context

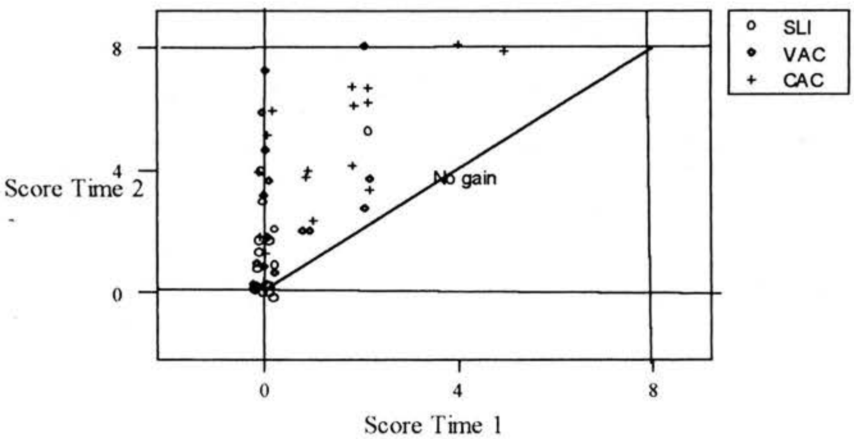


Figure 6.31 Gain in Word Recognition : Explicit Teaching Context

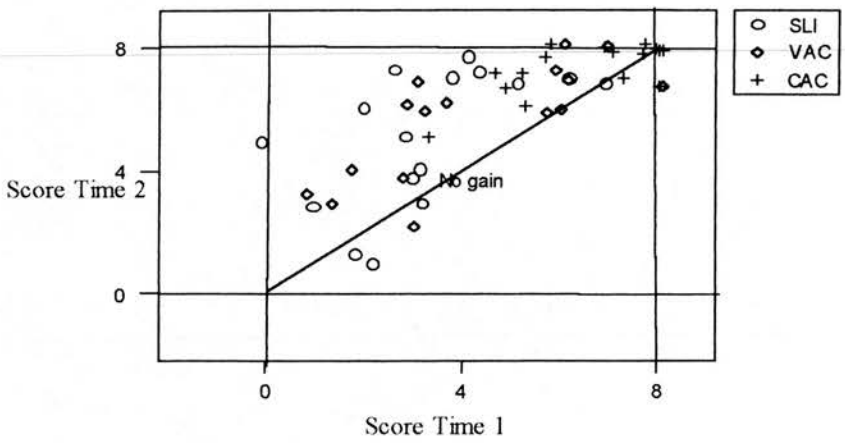


Figure 6.32 Gain in Word Description : Explicit Teaching Context

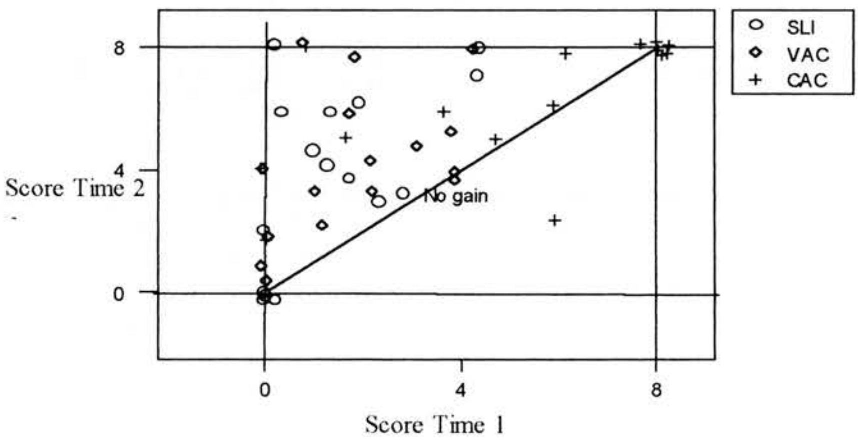


Figure 6.33 Gain in Meaning Recognition : Explicit Teaching Context

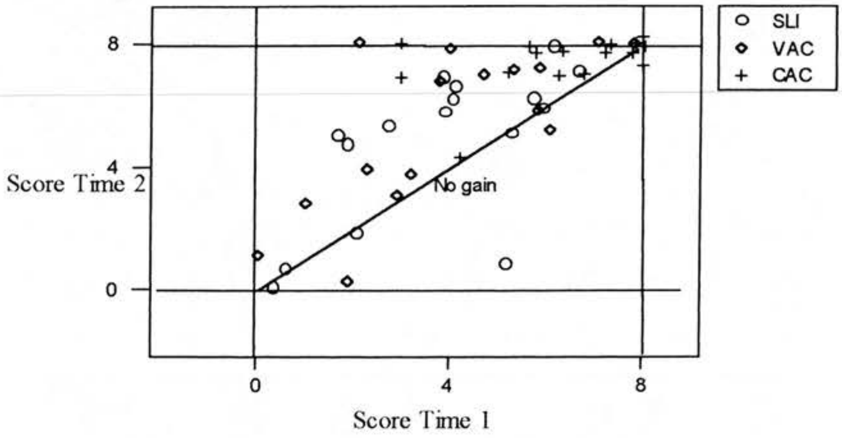
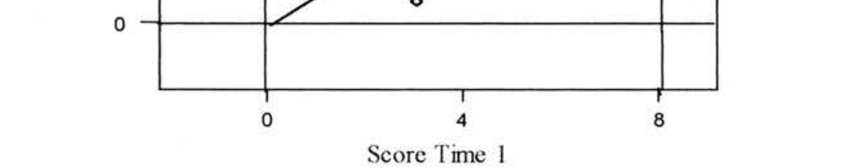


Figure 6.34 Gain in Picture Comprehension : Explicit Teaching Context



In summary an analysis of the patterns of gain suggest that:

- The majority of children in all groups scored more highly on all measures at Time 2 than they did at Time 1. This suggests that additional exposure was beneficial to many children in all the groups, including those with SLI.

- Ceiling effects restricted the potential amount of gain that could be demonstrated by individual children. These were a feature on all the scatterplots except Naming (both contexts) and Word Description (Story context), and were most evident in the CAC group.

The suggestion that all three groups of children benefit from extra exposure to the experimental words was analysed statistically to see if there was a significant improvement in learning on all the measures between Time 1 and Time 2.

Gain in learning for each measure was calculated for each group individually by subtracting children's scores at Time 1 from their scores at Time 2. A Wilcoxon Signed Ranks Test was performed on the gain on each measure from the Story and Explicit Teaching contexts separately for each group. Table 6.8 presents the results from both contexts.

Table 6.8 Gain in Learning in the Story and Explicit Teaching Context (Wilcoxon Signed Ranks Test)

	SLI			VAC			CAC		
Story	Median	Wilcoxon Statistic	p=	Median	Wilcoxon Statistic	p=	Median	Wilcoxon Statistic	p=
Naming	1.5	45	**0.005**	2.5	91	**0.001**	3.5	105	**0.001**
Word Recognition	2.0	133.5	**0.000**	1.0	101.5	**0.01**	1.0	82	**0.034**
Word Description	0.0	33	**0.021**	1.0	67.5	**0.014**	1.0	87	**0.002**
Meaning Recognition	1.0	75.5	**0.020**	2.0	129	**0.001**	0.5	44.5	**0.046**
Picture Comprehension	1.0	50	0.071	1.0	79	**0.011**	0.0	28	**0.011**
Explicit Teaching									
Naming	1.0	45	**0.005**	1.5	105	**0.001**	3.5	136	**0.000**
Word Recognition	2.0	99	**0.002**	1.5	98	**0.002**	1.0	52.5	**0.006**
Word Description	2.5	66	**0.002**	2.0	91	**0.001**	0.0	30	0.054
Meaning Recognition	1.0	36	0.062	1.0	80	**0.009**	1.0	52.5	**0.006**
Picture Comprehension	1.5	84	**0.04**	1.0	64	**0.027**	0.0	27	0.117

A Wilcoxon Signed Ranks Test (one tailed) suggested that each group was significantly better at Time 2 on almost all the measures. However children with SLI were not significantly better on Meaning Recognition of words from the Explicit Teaching context or on Picture Comprehension of words from the Story. On both tests though, there was a trend for their score to be significantly better at Time 2 (Picture Comprehension $p=0.071$ and Meaning Recognition $p=0.062$). The CAC group's gain was not significant on the Word Description or on the Picture Comprehension measure in the Explicit Teaching context although their improvement on the Word Description score at Time 2 was close to significance ($p=0.054$).

6.4.1.2 Did children with SLI benefit as much as controls from extra exposure to the experimental words?

It was also of interest to see whether the children with SLI improved their scores as much as the other groups between Times 1 and 2. At Time 2 children's scores reflect their accumulated learning from both Time 1 and Time 2, whereas the difference in scores when Time 1 is subtracted from Time 2 might indicate how much additional learning occurred as a result of the extra exposure to the experimental words at Time 2. If this gain was the same in children with SLI as in the control groups, this might indicate that, given a certain level of exposure, children with SLI could learn as much about the experimental words as their peers.

Gain in Story Context

Table 6.9 shows statistics for the three groups' gain in word learning from the Story context.

A Kruskal-Wallis one way analysis of variance showed that there was no significant difference among the groups for the amount of gain on any of the measures except Naming.

Table 6.9 Comparing gain between the three groups in the Story context (Kruskal-Wallis One-Way Analysis of Variance)

Story		SLI	VAC	CAC	df =2 H	p=
Naming	**Median** (range)	1.5 (0-3)	2.5 (0-7)	3.5 (0-7)	10.77	0.005
Word Recognition	**Median** (range)	2 (-1-6)	1.0 (-3-6)	1.0 (-3-8)	3.87	0.145
Word Description	**Median** (range)	0.0 (-1-3)	1.0 (-1-3)	1.0 (-1-5)	2.44	0.295
Meaning Recognition	**Median** (range)	1.0 (-2-5)	2.0 (-1-6)	0.5 (-3-3)	2.48	0.289
Picture Comprehension	**Median** (range)	1.0 (-3-4)	1.0 (-2-5)	0.0 (0-4)	0.33	0.847

Pairwise comparisons showed that the SLI children made significantly less improvement than both control groups in Naming words from the Story, SLI and CAC groups (Mann Whitney-U, one tailed, W=178.0, p=0.0005), SLI and VAC groups (Mann Whitney-U, two-tailed, W= 207.0, p=0.028).

Gain in Explicit Teaching Context

Group comparisons of gain from the Explicit Teaching context show similar patterns to those from the Story context.(See table 6.10) For Naming, the median gain of the SLI children was less than both control groups.

The Kruskal-Wallis test showed that there was no significant difference among the groups for the amount of gain on any measure except Naming.

Table 6.10 Comparing gain between the three groups in the Explicit Teaching Context (Kruskal-Wallis One-Way Analysis of Variance)

Explicit Teaching		SLI	VAC	CAC	df=2	
					H	**p=**
Naming	**Median** (range)	1.0 (0-4)	1.5 (0-7)	3.5 (1-6)	10.97	0.004
Word Recognition	**Median** (range)	2.0 (-1-5)	1.5 (-1-4)	1.0 (-1-2)	2.90	0.235
Word Description	**Median** (range)	2.5 (0-8)	2.0 (0-7)	0.0 (-4-7)	3.06	0.216
Meaning Recognition	**Median** (range)	1.0 (-4-3)	1.0 (-2-6)	1.0 (-1-5)	0.17	0.919
Picture Comprehension	**Median** (range)	1.5 (-2-4)	1.0 (-3-4)	0.0 (-2-3)	3.34	0.189

Pairwise comparisons showed that the SLI children made significantly less improvement on Naming than the CAC group (Mann Whitney-U, one tailed, W=175.5, p=0.0004). Although they also made less improvement than the VAC group on Naming, the difference only approached significance (Mann Whitney-U, two-tailed, W=217.5, p=0.07).

In summary the children with SLI, like the two control groups, made significant improvements on their Time 2 scores compared with their scores at Time 1. Furthermore the amount of gain made by the three groups did not differ significantly except on the Naming assessment from both contexts. On this, children with SLI made significantly less gain on words from the Story context than both control groups and significantly less improvement than the CAC group on words from the Explicit Teaching context.

6.4.2 Context and word learning

In another additional analysis in Study 2, contextual influences on children's learning within and between groups was explored.

6.4.2.1 Does context affect each group's word learning ?

The first of two questions looked at the effect of context on each group individually and specifically asked whether children's word learning was better in one context or another. If this was the case we would expect children's scores on the same measures to differ according to context.

A visual impression of any differences was created by drawing scatterplots. In these, the three groups' scores from the Story word learning measures were plotted against those from the Explicit Teaching context at Time 1 and Time 2 separately. Points falling above the diagonal line indicated those children who scored better when words were presented in the Explicit Teaching context. The converse was true for points below the line, and points on or close to the line identified individuals whose scores did not differ according to the context.

To establish whether context significantly affected each group's word learning, scores from the Explicit Teaching context were subtracted from their scores for the Story. A Wilcoxon Signed Rank test (two-tailed) was performed on this difference in scores for Time 1 and Time 2 separately for each group.

At Time 1 and Time 2 the effect of context was only evident on two measures, Word Description and Meaning Recognition. There was no significant difference in scores when the effect of context on Naming, Word Recognition or Picture Comprehension was compared in any of the groups.

In this section only the scatterplots of those measures where a significant difference in scores between the contexts was found will be displayed.

<u>**Time 1**</u>

Firstly Figure 6.35 below shows a large number of points above the diagonal line. These identify children who were better at Word Description (defining words) in the Explicit Teaching context than in the Story.

The cluster of points in the bottom left hand corner shows the children, (6 SLI, 3 VAC and 2 CAC) who scored zero points for defining words in both contexts at Time 1.

There was no evidence that context affected the children with SLI as a group on Word description at Time 1. In the controls however, the difference between the contexts was marked. In the VAC group 10 children performed better at defining words in the Explicit Teaching context as against two in the Story context. In the CAC group 11 children had higher scores for defining words in the Explicit Teaching compared with one in the Story context.

Table 6.11 shows that the difference in scores between contexts was significant in the control groups but not in the SLI group (VAC $p<0.05$, CAC $p<0.01$).

Figure 6.35 Comparing the effect of context on Word Description at Time 1

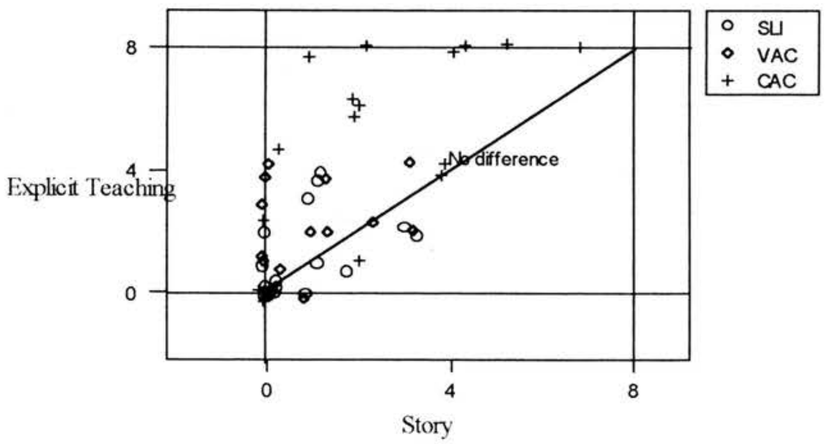


Table 6.11 Effect of context on Word Description at Time 1 (Wilcoxon Signed Ranks Test, two-tailed)

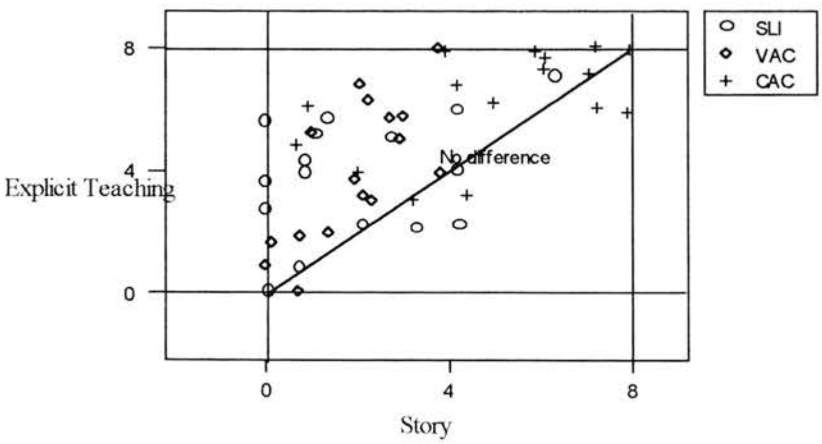
	SLI		VAC		CAC	
	#Median	Wilcoxon statistic	Median	Wilcoxon statistic	Median	Wilcoxon statistic
Word Description	0	12 p=0.236	-1	9 **p=0.021**	-3.5	1.5 **p= 0.004**

A negative median indicates a better performance on the Explicit Teaching context. A positive median suggests a better performance on the Story context

Meaning Recognition was the other measure where scores were significantly affected by the context in which words were presented.

In Figure 6.36 the scores from all three groups are more spread out and there was little evidence of the floor effects that had occurred on Word Description. Again the majority of points are above the line of "no difference", showing that most children were better at answering questions about the meanings of words (Meaning Recognition) which had been presented in the Explicit Teaching context.

Figure 6.36 Comparing the effect of context on Meaning Recognition at Time 1



Scores were found to be significantly better on words from the Explicit Teaching context when a Wilcoxon Signed Ranks Test (two-tailed) was carried out for each group separately (SLI $p<0.05$, VAC $p<0.01$, CAC $p<0.05$) Details are presented in Table 6.12.

Table 6.12 Effect of Context on Meaning Recognition at Time 1 (Wilcoxon Signed Ranks Test, two-tailed)

	SLI		VAC		CAC	
	#Median	Wilcoxon statistic	Median	Wilcoxon statistic	Median	Wilcoxon statistic
Meaning Recognition	-2	5.5 **p=0.01**	-2	3.5 **p=0.001**	-1.0	13.5 **p=0.028**

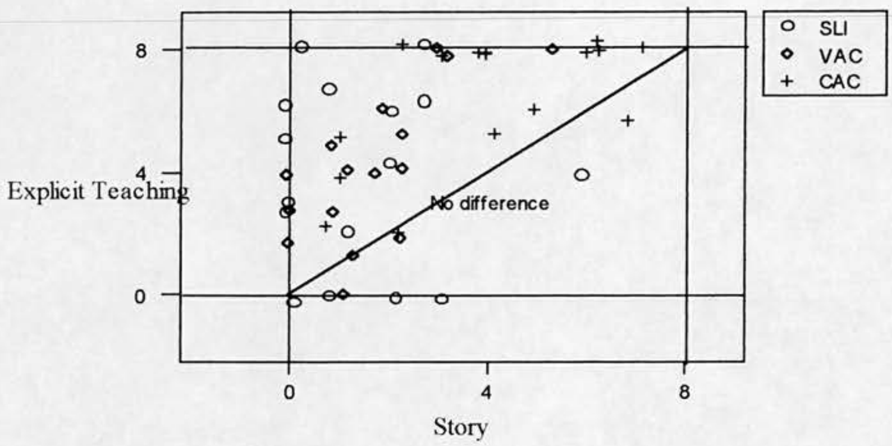
A negative median suggests a better performance on the Explicit Teaching context. A positive median suggests a better performance on the Story context.

Time 2

At Time 2 the Explicit Teaching context again boosted children's performance on Word Description and Meaning Recognition but not the other measures.

Figure 6.37 shows that the majority of points are above the line on Word Description at Time 2. Most children (11 SLI, 13 VAC and 14 CAC) were therefore achieving higher scores for defining words heard in the Explicit Teaching context than those heard in the Story.

Figure 6.37 Comparing the effect of context on Word Description at Time 2



A Wilcoxon Signed Ranks test (two-tailed) established that children in each group were significantly better at Word Description following the Explicit Teaching context (SLI, $p<0.05$; VAC and CAC, $p<0.01$). See also Table 6.13.

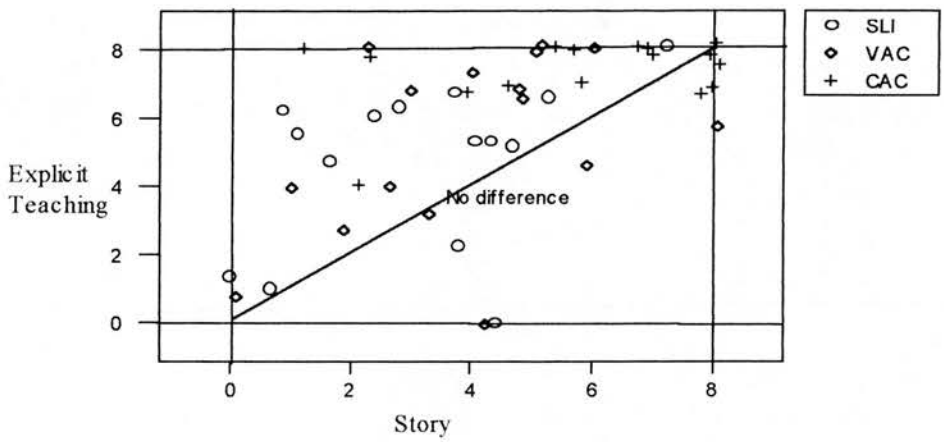
Table 6.13 Effect of Context on Word Description at Time 2 using Wilcoxon Signed Ranks Test (two-tailed)

	SLI		VAC		CAC	
	#Median	Wilcoxon statistic	Median	Wilcoxon statistic	Median	Wilcoxon statistic
Word Description	-3.0	17 **p=0.016**	-3.0	1 **p=0.001**	-2.0	3 **p=0.001**

A negative median indicates a better performance on the Explicit Teaching context. A positive median suggests a better performance on the Story context.

Figure 6.38 shows a similar pattern to Figure 6.37, again demonstrating that the majority of children in each group (SLI n=12, VAC n=12, CAC n=11) had higher scores for Meaning Recognition of words presented in the Explicit Teaching context than for those presented in the Story.

Figure 6.38 Comparing the effect of context on Meaning Recognition at Time 2



Statistical analysis again established the significantly beneficial effect of the Explicit Teaching context on Meaning Recognition, (SLI and VAC $p< 0.05$, CAC $p< 0.01$) The results are displayed in Table 6.14.

6.14 Effect of Context on Meaning Recognition at Time 2 using the Wilcoxon Signed Ranks Test (two-tailed)

	SLI		VAC		CAC	
-	# Median	Wilcoxon statistic	Median	Wilcoxon statistic	Median	Wilcoxon statistic
Meaning Recognition	-1.5	17.5 **p=0.030**	-2.0	22.5 **p=0.036**	-1.0	7 **p=0.008**

A positive median suggests that the children scored higher on the Story context. A negative median suggests they scored higher on the Explicit Teaching context.

In summary, the context comparisons within groups indicate that:

- At Time 1 children in all three groups were significantly better at answering questions about the meanings of words (Meaning Recognition) which had been introduced in the Explicit Teaching context. Both control groups (but not the children with SLI) were also significantly better at defining words (Word Description) introduced in the same context. At Time 2, the three groups performed significantly better on both the above measures for words introduced in the Explicit Teaching context.

- Context did not appear to affect any group's performance on Naming, Word Recognition or Picture Comprehension at either Time 1 or Time 2.

Thus children's ability to learn semantic (but not phonological) information was affected by context.

6.4.2.2 Was word-learning in children with SLI affected by context to the same extent as in controls?

It addition to comparing word learning from each context within each group, the data were also analysed to see whether the difference in scores between the contexts was the same when the three groups were compared.

On each measure, the children's scores from the Explicit Teaching context were subtracted from their score for the Story context and the differences among the three groups were compared at Time 1 and Time 2 using Kruskal-Wallis One-way Analyses of Variance. There was a significant difference between the groups on only one assessment, Word Description at Time 1 ($H= 8.54$, $p<0.05$).

Pairwise comparisons (Mann Whitney U, two-tailed) showed that the favourable influence of the Explicit Teaching context on the acquisition of semantic information for the new words was significantly greater in the CAC group than in the SLI group ($W=335$, $p<0.01$). There was no significant difference between the SLI and VAC groups.

Therefore in summary, the groups did not differ in the extent to which their performance was influenced by context, with the exception of Word Description at Time 1. Children with SLI like those with normal language development found it harder to deduce meaning from context, and mainly to the same degree as controls. That is they did not appear to have a disproportionate difficulty acquiring meaning from the Story contexts as compared with their ability to learn meanings in more supportive contexts. This conclusion may have to be tempered with the same caveat as the conclusion about the effect of context on phonological learning. Ceiling effects may also have obscured differences in the degree to which some measures could reflect contextual differences particularly in the CAC group.

6.4.3 Further additional analyses

The effect of additional exposure and context on children's words acquisition was investigated and reported in sections 6.4.1-6.4.2 because the data presented as bar charts in section 6.2, suggested that these characterises might merit further analysis.

Over and above these however, it was decided to pursue some further analyses including (1) the effect of word length on phonological learning and (2) the extent to which results in Study 2 were affected by the individual words used in the experiments.

6.4.3.1 Word length comparisons

In each context there were two 2-syllable words, one 1-syllable word and one 3-syllable words. The main aim of this aspect of the design was to simulate the demands of learning words in the 'real world' where children come across long and short words, by including a variety of word lengths. However this feature of the design also allowed some additional analysis to see whether word length affected children's ability to learn the phonological aspects of new words.

A comparison was made between children's performance on one syllable and three syllable words because there were equal numbers of words of these lengths. Only those measures which differentially emphasised phonology were compared. Also the scores for the Naming and Word Recognition measures from both contexts were combined to give a potential score of eight, because if looked at separately the possible range of scores was very small. These combined scores for three syllable words were subtracted from the combined scores for one syllable words within each group at Time 1 and Time 2 separately. The difference between the one and three syllable words was analysed using a Wilcoxon Signed Ranks Test (two-tailed). Results indicated that the one syllable words were not significantly easier to learn in any of the three groups at either Time 1 or Time 2, and instead it appeared that in the VAC group at Time 2, phonological information for three-syllable words was significantly easier to learn. These results are displayed in Table 6.15.

Table 6.15 Effect of word length on phonological learning at Time 1 and Time 2; Wilcoxon Signed Ranks test (two-tailed)

	SLI		VAC		CAC	
	Time 1	**Time 2**	**Time 1**	**Time 2**	**Time 1**	**Time 2**
#Median	0	-1	0	-1	0	-1
Willcoxon Statistic	39	39	20	4	40.5	14
p=	1.00	0.244	0.266	0.003	0.753	0.055

A positive median indicates performance was better on one-syllable words. A negative median indicates performance was better on three-syllable words.

The results indicate that with one exception (the VAC group at Time 2) word length did not significantly affect the acquisition of phonological information for the experimental words (although there was also a trend for a similar pattern to the VAC group to occur in the CAC group at Time 2).

6.4.3.2 Word Comparisons

In addition to analyses which addressed the extent and nature of word learning difficulties in children with SLI, analyses of the children's performance on the individual words were carried out. The purpose of this was to investigate whether individual words were making a significant contribution to the pattern of results obtained and therefore to give an indication of the extent to which results using these words can be extended to nouns in general.

The groups' performance on each measure from each context was analysed separately at Time 1 and Time 2. For each word, the original three point scoring system (whereby a child could score 0, 1 or 2) was collapsed into two. Scores of one and two were taken together as the category 'something right.' Scores of zero were categorised as 'nothing right.'

Firstly percentages of children in each group scoring 'something right' on each word were calculated for every word learning assessment at Time 1 and Time 2 separately. These are presented in Appendix 29.

After the percentages were calculated the words were compared with respect to the number of children in each category for each word using a chi-square test (where cell values allowed).

Chi square analyses were performed for each word set (Story and Explicit Teaching) for each group on each measure at Time 1 and Time 2 separately. This meant that there were 30 chi square analyses carried out on Time 1 data and a further 30 on Time 2 data.

Time 1

Table 6.16 displays the results of chi-square analyses on the differences between each groups' performance on the individual words by assessment at Time 1. Shaded areas of the table indicate those assessments where a significant chi-square result occurred. Within the shaded area, the individual words which made large contributions to the overall chi-square are identified.

Table 6.16 Assessments at Time 1 with significant Chi-Square results for word effects and individual words contributing to these.

Assessments	SLI	VAC	CAC
Naming (Story)			
Naming (Explicit Teaching)	N/A	albatross	albatross, mica
Word Recognition (Story)			
Word Recognition (Explicit Teaching)			albatross
Word Description (Story)			
Word Description (Explicit Teaching)			
Meaning Recognition (Story)			
Meaning Recognition (Explicit Teaching)			
Picture Comprehension (Story)		aster, phial	
Picture Comprehension (Explicit Teaching)			

N/A computation of chi square impossible because some expected frequencies zero or chi-square approximation probably invalid because of the number of cells with expected counts of less than 1.

None of the analyses of the SLI data were significant. However two significant chi-square results occurred in each of the control groups. In the VAC group, these were Naming in the Explicit Teaching context (chi-square=9.329, p=0.025) and Picture Comprehension in the Story context (chi-square =10.667, p=0.014). In the CAC group, these were Naming and Word Recognition in the Explicit Teaching context (chi-square =14.89, p=0.002 and chi-square=12.8, p=0.005 respectively). Post hoc inspection of the data for each word suggested that on the Naming test, the word *albatross* made the biggest contribution to the overall chi square in both the CAC and VAC groups with more children than expected scoring 'something right' for this word. However on this assessment, in the CAC group the word *mica* also made a substantial contribution to the chi square with fewer than expected children getting something right. In Picture Comprehension of words from the Story context the words *aster* and *phial* made a large contribution to the overall chi square result in the VAC group because on the former more children than expected were scoring 'nothing right' and on the latter fewer children than expected were falling into the category 'nothing right'. Finally, the word *albatross* again made a big contribution to the chi square on Word Recognition in the Explicit Teaching context for the CAC group. On this measure however, more children than expected were getting 'nothing right'.

Time 2

Table 6.17 displays the results of chi square analyses on the differences between each groups' performance on the individual words by assessment at Time 2.

It was not possible to compute five of the chi square tests because some expected frequencies were zero or because there were four cells with counts less than one. Of the remaining 25 chi square analyses, only six measures showed a significant difference between the words. These are identified as shaded boxes in the table with the individual words which made a large contribution to the overall chi-square identified.

Table 6.17 Assessments at Time 2 with significant Chi-Square results for word effects and individual words contributing to these

Assessments	SLI	VAC	CAC
Naming (Story)		phial	
Naming (Explicit Teaching)	albatross	albatross	
Word Recognition (Story)			N/A
Word Recognition (Explicit Teaching)			N/A
Word Description (Story)		polka, phial	polka, phial
Word Description (Explicit Teaching)		kale	
Meaning Recognition (Story)			
Meaning Recognition (Explicit Teaching)			N/A
Picture Comprehension (Story)			N/A
Picture Comprehension (Explicit Teaching)			N/A

N/A computation of chi square impossible because some expected frequencies zero or chi-square approximation probably invalid because of the number of cells with expected counts of less than 1.

In the SLI group, one result, naming words from the Explicit Teaching context just reached significance (chi-square = 7.924, p=0.048). The word *albatross* was making the largest contribution to the chi square with more children than expected getting 'something right'.

In the VAC group there were four significant chi square results. These occurred on Naming (Story context, chi-square =9.0, p=0.029 and Explicit Teaching context, chi-square=9.651, p=0.022) and Word Description (Story context, chi-square = 19.117 p=0.000 and Explicit Teaching context, chi-square=10.955, p=0.012). Inspection of the individual word data suggested that the biggest contributions to the total chi-square value were made as follows. In the Explicit Teaching context, more children than expected were getting a score of 'something right' for the word *albatross* on the Naming assessment, and more children than expected were falling into the category 'nothing right' for the word *kale* on Word Description. In the Story context (Word Description), more children than expected were scoring something right for *polka* but fewer than expected got 'something right' for *phial.*

In the CAC group there was one significant chi square result, Word Description of Story words (chi-square=11.553, p=0.009.) On this assessment more children than expected were scoring 'nothing right' for the word *phial.* However fewer children than expected fell into the category 'nothing right' for the word the word '*polka*' and this also contributed to the overall significant chi-square result.

In summary there was little difference between the words in any of the three groups. Firstly there was only a significant difference between the words on one assessment in the children with SLI. Among their vocabulary age matched and age matched controls, there were some differences between the words, although the particular words found difficult varied with the assessment. The word *albatross* seemed easier to name in all groups however. This was apparent at both Times 1 and 2 in the VAC group, at Time 1 in the CAC group and at Time 2 in the SLI group. Because this word seemed easier for all the groups at some point, it suggests that the word itself may have been easier, rather than it being easier for a particular group.

Therefore the analysis of children's performance on individual words suggests that for the most part results of between group comparisons in Study 2 were not due to the influence of particular words.

Looking at within group comparisons the word *albatross* (as a word that all 3 groups seemed to find easier to name) may have contributed to some of the results in section 6.4.3.1 which suggested that the phonological information for 3-syllable words is easier to learn than for one-syllable words. In addition, the word *phial* from the Story context seemed 'particularly hard' for Word Description in the VAC and CAC groups at Time 2. This may have contributed to the significantly better performance on Word Description on words from the Explicit Teaching context when the two contexts were compared within groups at Time 2. However at Time 1, on Word Description the chi-square analyses were not significant in any of the groups, and yet the within VAC and CAC group comparisons as to the effect of context were still significant at Time 1.

6.5 Discussion of the results from Study 2

The results from Study 2 will now be considered. Firstly the individual research questions posed in Study 2 will be reiterated and the results discussed in relation to them. Following this, the results of analyses which were carried out in addition to those required to address the specific research questions will be discussed. Finally the way in which the results from Study 2 motivated the investigations for Study 3 will be described.

6.5.1 The extent of word learning deficits in children with SLI.

The first research question in Study 2 asked the following:

- Do children whose SLI includes a vocabulary deficit have word learning difficulties, and if so what is the extent of these ?

It will be recalled that in the literature review there was no clear consensus in prior research about whether children with SLI had word learning difficulties. This lack of agreement appeared to be due to the different experimental paradigms, the characteristics of the children with SLI studied, and the control groups with which they were compared.

In Study 2 however, the extent of the word learning difficulties in this group was clearly demonstrated. Children with SLI had significantly poorer scores for their total word learning (i.e. the sum of all the measures of word learning from each context separately, at Time 1 and Time 2 separately) than the CAC group, irrespective of the context in which the words were presented, or additional exposure. This suggested that children with SLI did indeed have word learning difficulties. The extent of these was apparent when the median scores of the SLI group were compared with controls. At Time 1, the median score of the children with SLI on words from the Story was just over a third of that of the CAC group and less than half of this group's score for words from the Explicit Teaching context. At Time 2, despite extra exposure to the new words, children with SLI still had median word learning scores in both contexts which were lower than the CAC group's median scores at Time 1. This indicates a very marked deficiency in word learning compared with children of the same age.

When compared with children at the same level of receptive vocabulary development (the VAC group), those with SLI also had lower medians on all the TWL scores but the differences were not significant. This comparison also suggests that children with SLI have word learning problems because their TWL was only as good as a group who were on average two and a half years younger.

The way in which the findings of Study 2 extend our understanding of word learning from previous research will now be considered. Because of the different experimental paradigms used in other studies, it will be appropriate to discuss the results from each context separately.

In the <u>Story</u> context at both Time 1 and Time 2, children with SLI had much poorer scores for TWL than the CAC group, and were poorer than the VAC group, although the differences were only significant when the SLI and CAC groups were compared.

Thus children with SLI had considerable difficulties learning new words presented in a context where no explicit attention was drawn to the experimental words and where no adult support was given to children to help them learn. These results therefore support the work of Oetting, Rice, & Swank (1995), Rice, Buhr, & Oetting (1992), Rice, Buhr, & Nemeth (1990), Rice, Oetting, Marquis, Bode, & Pae (1994). These authors, using an experimental paradigm which had aspects in common with the Story in Study 2, also reported that difficulties in acquiring new vocabulary from naturalistic opportunities characterised children with SLI. However Study 2 differed in another respect from the results of one study by this group of researchers (Rice et al., 1994). They found that, having heard the new vocabulary ten times, children with SLI learned as many new words as children the same age. In Study 2 this was not the case. Even at Time 2 when the children with SLI had heard the words a total of twelve times in the learning opportunities, their complete score for word learning was considerably and significantly poorer than that of the CAC group. Furthermore after 12 exposures to the words at Time 2, the SLI group had not even caught up on the CAC group's Time 1 median score. Similar concerns about the rate of vocabulary acquisition were also expressed in the study by Oetting et al. (1995) where the gain in learning in the children with SLI was less than half that of their peers. In relation to this, these authors stated that "it does not seem to be the case that the quick incidental learning abilities of children with SLI catch up, or parallel in rate, the ability of their normally developing peers" (p. 442).

Word learning problems in children with SLI were not only apparent in the Story context. In the Explicit Teaching context, where the referents for the unfamiliar words were obvious and the meaning was clearly defined, the pattern of results was the same. Children with SLI were significantly poorer than age matched controls but not significantly different from much younger children matched for vocabulary.

The former observation broadly corresponds with the results of a group comparison by Kiernan & Gray (1998) who also found that as a group children with SLI were significantly poorer than age matched controls at word learning in a supported learning context (even though these authors also stressed similarities between the groups in their word learning ability). However the results from Study 2 suggested rather poorer word learning in children with SLI than was found by Leonard et al. (1982). In this research children with SLI were superior in aspects of their word learning to children matched for level of language development. However although Leonard et al.'s study, like the Explicit Teaching context, offered the children direct support to learn the new words (e.g. by drawing the children's attention to them), there were many methodological differences, including number of sessions, and number and type of words. Most importantly perhaps was the fact that the comparison group were very young indeed and only between 1;5 and 1;10 years. Thus the superior word learning in the SLI group may have occurred as a result of experiential and other developmental advantages in children who were considerably older (2;8 -4;2 years). The difficulty in interpreting results from comparisons between children with SLI and language matched controls is returned to in Chapter 7.

Thus Study 2 strongly suggests that children with SLI have considerable word learning difficulties and that these occur whether words are encountered in contexts with more or less support for learning. The results also suggest the vocabulary deficits in this group are unlikely to be due to factors such as reduced opportunities in the environment for learning new words because the extent of their problem was apparent when the amount of exposure and the contexts in which the words were embedded were the same for the SLI and control groups.

6.5.2 What is the nature of the word learning difficulty in children with vocabulary deficits?

An important question about the nature of the word learning deficit was whether children with SLI had difficulty acquiring the phonological or semantic aspects of the lexical representations for new words or whether they had problems with both.

The results from Study 2 indicate that children whose SLI includes a vocabulary deficit have rather global problems with learning new words in that they had difficulty acquiring both phonological and semantic information. However there was a suggestion that their difficulty with learning the phonological representations for new words was more marked because their performance on an assessment which differentially emphasised phonology was poorer than even the much younger vocabulary-age matched controls.

These results are important for a number of reasons. Firstly they were derived from a larger group of children with SLI than most previous research and from word learning in more than one context. Thus they present a more comprehensive picture of word learning in children with SLI than in previous research.

Secondly and importantly, they corroborate the assertion that difficulties acquiring phonological information may be significant in explaining vocabulary deficits in children with SLI (Constable, Stackhouse, & Wells, 1997; Dollaghan, 1987; Gathercole, 1993; Haynes, 1982). This has been a largely neglected area in the study of vocabulary deficits until recently.

Thirdly, Study 2 extends and balances the important emphasis on a phonological learning deficit by also highlighting the poorer semantic learning in a group of children with SLI. This more global conception of word learning difficulties is important when we consider the recent shift away from an initial focus on semantic inadequacies in lexical deficits (Kail & Leonard, 1986; Leonard, 1988) to the opinion (Gathercole, 1993) that phonological learning deficits are paramount. While this has been an important development in our understanding of lexical problems it would be a concern if the broader nature of word learning deficits in children with SLI was ignored.

The results of Study 2 therefore suggest that children with SLI have difficulties with acquiring phonological <u>and</u> semantic information for new words. As such these findings are consistent with some but not all the conclusions from previous research.

For example while the results of Study 2 agree with the concerns of some authors who identify difficulties with the acquisition of phonological information (Dollaghan, 1987; Haynes, 1982), they do not agree with these authors' views that difficulties acquiring semantic information are not a problem or are secondary to the phonological learning problems in children with SLI. In the first of these studies, Dollaghan (1987) suggested that children with SLI were similar to controls in many of the aspects of fast mapping of new vocabulary except for phonological information. This implied that the fast mapping of semantic information, which was presumably deduced from the comprehension task they had devised, was as good as in controls. However such a conclusion must be viewed with caution given the simple and undemanding nature of the comprehension task and the fact that only one word was introduced and tested. In Study 2 the requirements for acquiring semantic information were considerably greater because there were more words presented in more demanding contexts.

Haynes (1982) provided more powerful evidence for a phonological learning deficit in children with SLI. This was based on their significantly poorer performance than vocabulary-age and age-matched controls at recognising the correct pronunciation of recently introduced nonwords in a story (the word learning test). The SLI children were, however, also poorer at identifying pictures of named items from the story (the concept acquisition test). Haynes went on to correlate performance on the two tests and found a significant positive correlation between the acquisition of the phonological form and the acquisition of the meaning. In this work, the implication was that the SLI children's performance on the concept acquisition task was compromised by their poor phonological learning. In Haynes' words (p.22): "In vocabulary development, some unfading phonological representation is needed to peg a semantic concept to, in order for a word to be acquired. It is argued that the Language Disordered children do not develop word perception normally and hypothesised that their poor storage of any unfamiliar phonological form will make concept formation difficult". An alternative explanation however was that the SLI children were also poor at acquiring meaning. In any event a positive correlation between these two dependent variables cannot be considered causal, and children with SLI in Haynes' study, as in Study 2, may have had both phonological and semantic learning deficits.

The finding in Study 2 that children with SLI have trouble acquiring semantic information for new words is also in line with the results of the studies by Oetting et al. (1995) and Rice et al. (1994) who provided evidence that children with SLI were limited in their quick initial comprehension of new words. The post test of word learning in these studies was a picture comprehension task and therefore, as in Study 2, children with SLI were significantly poorer than controls on a task which differentially emphasised semantic learning. That is not to say that failure on assessments of semantic learning task is clear evidence that children had difficulty only acquiring semantic information about unfamiliar words. As was suggested in Chapter 3, section 3.1.4, few measures of word learning can be considered 'pure' in that they only to tap phonological *or* semantic information. For example in the tasks which tap semantic learning the child has to have stored enough phonological information about the word being tested to recognise it and thereby gain access to the information about meaning which has been stored. Failure on a picture comprehension task (or on the other tests of semantic learning) could therefore occur if children had insufficient phonological information stored about a given word. Furthermore children also have to have made correct links between the words' phonological forms and their meanings (see Chapter 3, section 3.1.4) in order to be successful on assessments of word learning .

Finally the results of Study 2 may go some way to explaining the lack of consensus on the best approach to intervention mentioned in Chapter 2. Although studies aimed at improving lexical deficits have mainly included children with Word-Finding Difficulty, some have evaluated a phonological approach to it (McGregor, 1994), some a combination of phonological and semantic strategies (Easton, Sheach, & Easton, 1997; Hyde-Wright, 1993) and some have compared a phonological and a semantic approach to remediation (Hyde Wright, Gorrie, Haynes, & Shipman, 1993; Wing, 1990). Somewhat confusingly, Hyde Wright (1993a) found semantic therapy more beneficial than a phonological approach, Wing (1990) found a phonological and perceptual treatment more effective than a semantic approach and Easton et al. (1997) and Hyde Wright (1993b) found therapy which included a combination of semantic and phonological approaches improved word-finding to some extent. Although these approaches were designed to specifically target word-finding difficulties, the fact that phonological and semantic strategies appeared to have some beneficial effect is generally in line with the notion that phonological **and** semantic difficulties may underpin lexical deficits.

In conclusion then, Study 2 provided a more a comprehensive picture of the nature of word learning difficulties in children with SLI than has been identified previously. This was probably because of the methodology employed (different contexts, two trials) and particularly because of the range of assessment tasks administered following the learning opportunities.

6.5.3 Do children with SLI benefit from repetition of 'new' words?

Because children's word learning was assessed following the first learning opportunity for each context (Time 1), and again after the second learning opportunity (Time 2), it was possible to carry out some additional investigations using the data from Study 2. In particular it was possible to study whether extra repetition of the experimental words helped children with SLI learn, and if so, whether repetition was as helpful to them as it was to children with normal language development.

Firstly it was encouraging that children with SLI (like the children in the control groups) had significantly improved scores at Time 2 on the majority of word learning assessments, suggesting that as a group they had benefited from extra exposure to the experimental words. In answer to the question do children benefit from extra exposure the answer seems to be that for the most part this is a helpful aid to children's learning and it concurs with Rice et al.'s (1994) finding that children with SLI who heard words 10 times performed better on a picture comprehension test than those who only heard the words three times. It is also in line with the study by Robbins & Ehri (1994) which investigated young children's vocabulary learning from a story and found that words heard four times were generally (though not inevitably) associated with higher rates of acquisition than those heard only twice.

It is tempting therefore to suggest that repetition is a powerful remediation strategy for children with SLI in view of the significant gain they made on most measures at Time 2. However this may not be the case for all children with SLI as a number of individual children did not improve on their Time 1 scores and this lack of gain was rarely due to ceiling effects in the Time 1 scores (unlike in the CAC group). For example on the Word Description assessment in the Explicit Teaching context, five children with SLI and eight in the CAC group did not improve their scores. However four of the SLI children had scores of zero at both Time 1 and Time 2 while six of the CAC group had scores of eight at Time 1 and Time 2. Therefore in one group the lack of gain was due to a failure to learn with additional exposure while in the other, ceiling effects at Time 1 constrained their ability to demonstrate gain.

An additional point is that a score of zero at Time 1 and Time 2 was predominantly a feature of the SLI, and to a lesser extent the VAC group mainly on Naming and Word Description of words from both contexts. These very low scores at Time 1 and 2 suggest that there are children who are very poor learners indeed and who remain so even after additional opportunities to learn.

It was however encouraging that when between group comparisons were made, there was no significant difference in the amount of gain made by the children with SLI on any of the assessments except Naming. This may indicate that in general, children with SLI add as much to their word learning from the additional exposure at Time 2 as children with normal language development.

However closer scrutiny of the data suggests that this may be over optimistic. When individual scores were inspected it was clear that a number of children in the CAC group were at, or close to the top of the range of scores at Time 1 on all the assessments except Naming (both contexts) and Word Description (Story context). This meant that it was not possible for them to add much or anything at all to their scores at Time 2 and therefore their potential median gain was greatly limited. This in turn may have obscured differences in the amount of gain when the SLI and CAC groups were compared.

In summary then, children with SLI did not benefit as much from extra exposure as the CAC and VAC groups when tested on their ability to name pictures of the experimental words, suggesting a widening gap in their naming ability at Time 2. Besides this, they only gained as much from extra exposure on most measures as the younger group matched for vocabulary and their apparently equal gain to age matched peers can, in most cases, probably be explained by ceiling effects.

If it is indeed the case that children with SLI make only as much or even less improvement with repetition than children with normal language development, they will not close the gap in learning (evident at Time 1) between themselves and their peers. And, given their initially inferior performance, in some cases the gap may even widen. Then, when one takes account of the sheer volume of vocabulary to be acquired, it is easy to see how in situations where no particular remediation is offered, children with SLI may fall further and further behind in their vocabulary development.

6.5.4 Is word learning in children with SLI influenced by the context in which the new words are presented?

It will be recalled that when the effect of context on the ability to learn phonological and semantic information was compared within the groups, children were significantly better at defining the experimental words and at recognising their meanings when tested on words that had been presented in the Explicit Teaching context. However there was no significant effect of context on children's ability to name pictures of the experimental words or to recognise their correct pronunciation from a choice of four. Thus in all three groups, context appeared to affect semantic, but not phonological learning.

This result can be most easily understood if we consider the similarities and differences in the way words were presented in the Story and the Explicit Teaching Context.

An important difference between the contexts was the way in which meaning was presented. In the Explicit Teaching context the children were given a basic definition for each word, including a category (e.g. it's a bird), and an attribute (e.g. it's big). In contrast, although these aspects of meaning were available from the text and pictures in the Story, the words were never explicitly defined. Instead the child had to deduce the meanings of the experimental words. The results of Study 2 suggest that making the meaning of words explicit is helpful to all children. This supports the work of Pany, Jenkins, & Schreck (1982) who also found that intervention where students were given information about the meaning of words resulted in better vocabulary learning than a procedure where students had to infer meanings from context. That is not to say however that children did not learn word meanings from the Story (even children with SLI had a median score of one and a range of six for defining words at Time 2) - only that it was comparatively more difficult. These results therefore endorse the findings and suggestions of Robbins & Ehri (1994) who reported that five and six year old children learned the meaning of new words from stories (as assessed on a multiple choice post-test), but proposed that vocabulary gains might have been increased by discussing the new words (a strategy similar to that employed in the Explicit Teaching context).

Although the contexts differed greatly in the way that the experimental words' meanings were presented, an important similarity was that each context provided an equivalent amount of exposure to the words' phonological forms, because the words were repeated the same number of times. This may have been one reason why there was no effect of context on the assessments which differentially emphasise phonology. It could be argued however that despite occurring the same number of times in each context, experimental words presented in the Explicit Teaching context were more salient than those in the Story. This was because in the former they were specifically introduced one by one, whereas in the Story they occurred as part of an interesting text but with no specific attention drawn to them. In this situation one might expect that children would benefit from the way in which the Explicit Teaching context highlighted the phonological forms of the words which in turn would lead to a better performance on the phonological assessments. This apparent difference in the contexts however had no effect on children's phonological learning. One possible reason is that any advantages to phonological learning provided by increased salience in the Explicit Teaching context may have been balanced by the Story having greater interest and appeal as a context for word learning.

6.5.5 Does word length affect phonological learning?

Some additional analyses of children's ability to learn longer three syllable words, compared with shorter one syllable words was carried out. This suggested that, for the most part, word length did not significantly affect children's ability to acquire the phonological aspects of new words, except in the VAC group at Time 2 when children performed better on assessments involving longer rather than shorter words.

The performance of the VAC children at Time 2 (but not the other groups, or the Time 1 results) supports the observations by Gathercole & Baddeley (1990) that children found it easier to repeat two syllable words than one syllable words. These authors thought however that this was an artefact of the phonological composition of the particular set of one syllable words in their test rather than a true effect. It is possible that the same was true of the words in Study 2, although the simple phonological structure of the one syllable words used makes it unlikely.

The results also agree to some extent with Rice et al. (1994) who found long words easier to learn than short words. In particular three syllable words such as *crustacean* and *excavate* were easier for children to learn than the one syllable words *sphere* and *sprint*. Consequently Rice suggested that the number of syllables to be represented did not predict performance on individual words.

The notion that word length does not affect children's ability to learn phonological information or that children learn long words more easily than short words is difficult to accept however when one considers the link between non word repetition, phonological memory and vocabulary acquisition (Gathercole & Baddeley, 1990; Gathercole, Hitch, Service, & Martin, 1997; Gathercole, Service, Hitch, Adams, & Martin, 1999), the finding that nonword repetition accuracy is affected by word length (Gathercole, Willis, Emslie, & Baddeley, 1991) and the intuitive expectation that more phonological information should be harder to retain than less information.

A possible explanation might be that children's scores on Word Recognition only indicated whether the most salient phonological segments of a word had been retained. Consequently it is possible that word length did not affect performance on Word Recognition. Therefore when Word Recognition and Naming were combined, difficulties naming longer words may have been masked. This hypothesis was not confirmed when the raw data for naming one and three syllable words were analysed using a sign test. This showed that at Time 1 the CAC group was significantly better at naming 3-syllable words than they were at naming the 1-syllable words ($p<0.05$). At Time 2 both the SLI and VAC groups were also significantly better at naming 3-syllable words than they were at naming 1-syllable words ($p<0.05$ and $p<0.01$ respectively). This result therefore added weight to the notion that acquiring phonological information may be easier for longer words than for shorter words because this was the case even when the possible masking effect of the Word Recognition scores was removed from the analysis.

One final point is that the better scores on naming three-syllable words could be possibly attributed to the word *albatross* which all three groups of children found easier to name than the one syllable words. (see section 6.4.3.2)

6.6 From Study 2 to Study 3.

It was stated in Chapter 2 that this thesis would take a two stage approach to investigating vocabulary deficits. Study 2 addressed the first stage and established that children with SLI have word learning difficulties and that the extent of these was considerable. Importantly it also suggested that while the nature of their word-learning difficulties was rather global, children with SLI might be particularly poor at acquiring phonological representations for unfamiliar words.

In the second stage of the research Study 3 will investigate the ability to acquire the phonological representation for new words (phonological learning). It will focus on the possible reasons for the difficulties children with vocabulary deficits have in acquiring phonological information. This was chosen as the subject of the investigation in Study 3 because although the children with SLI were significantly poorer than chronological-age matched controls on assessments of both phonological and semantic learning , they were only significantly poorer than the VAC controls on Naming, an assessment which differentially emphasises phonological learning. In pursuing this line of enquiry there is an implicit assumption that the particular difficulties which the SLI group had on the Naming test in Study 2 were due to problems acquiring a phonological representation for the experimental words. This is a reasonable assumption if we agree that naming requires that "an accurate phonetic code be generated from a completely specified phonological representation" (Swan & Goswami, 1997) and that naming problems would occur on words for which the child had not a acquired phonological representation.

However it is also acknowledged that the poor performance on Naming by children with SLI could have been due to other explanations. For example it has already been discussed that the assessments used in Study 2 only differentially emphasise either semantic or phonological learning. For example Ellis & Young (1988) suggest that when naming a picture, recognising the picture activates the information stored about a word's meaning (the semantic representation) which in turn links to the spoken form of the word to be used. Two aspects of this account (underlined) point to other possible sources of naming difficulty.

Firstly it is possible that children with SLI had stored a phonological representation but could not retrieve this on demand. Scrutiny of their responses on the Word Recognition task (where they had to select the correct pronunciation from a choice of four) suggested that naming difficulties were more indicative of a difficulty acquiring phonological information than retrieving it because there was evidence of children scoring poorly on Word Recognition as well as Naming for the same words.

Alternatively a lack of semantic information might have affected the SLI group's naming performance. Data from Study 2 however suggested that this was not the whole explanation for naming difficulties because children had difficulty naming even when they could demonstrate that they had stored information about the words' meanings. For example, children with SLI were significantly better at Word Description than on Naming in the Explicit Teaching context at Time 1 and Time 2. Furthermore when some scores for individual words were inspected there were children who scored full marks for defining the words' meanings yet were unable to name a picture of the same item.

Ellis & Young's (1988) explanation also emphasises the link between phonological and semantic information and one might speculate that if this is not correctly or adequately established, a naming error might result. Mostly however when a child scored zero for naming a particular word, this was because the response did not include enough or any of the target word (to score 1 or 2). However on some occasions children did produce part or all of a different experimental word for the picture. Furthermore when data from the Word Description task were scrutinised, there was evidence that errors included responses where children provided the meanings for one of the other experimental words rather than the one being tested. For example (that *phial* was a flower, or that *mica* was a glove). This suggests that on some occasions an inaccurate link between phonological and semantic representations might have been established. Consequently in Study 3 it was also decided to study children's ability to form associations between items of information.

In Study 3 the acquisition of phonological representations will be investigated further in a task where there are no demands to deduce or acquire meaning. In addition the ability to link components of the lexical representation will also be investigated.

Finally the speech sound processing and phonological memory abilities considered important for laying down new phonological representations will be studied and the relationship between these and phonological learning explored.

These studies will form the core of Study 3 and will aim to establish the source of the difficulties children with SLI had with the phonological aspects of word learning.

CHAPTER 7 STUDY 3: A STUDY OF PHONOLOGICAL LEARNING AND PHONOLOGICAL PROCESSING AND MEMORY

7. Introduction

Study 2 was an important first step in understanding the extent and nature of the problem with vocabulary acquisition in children with lexical deficits. It suggested they had considerable difficulty learning new words compared with children the same age, that they had global word learning problems but that acquiring phonological information might be a particular difficulty. In this chapter, the rationale for Study 3 will be presented, followed by the research questions, method and results. Finally the results will be discussed and their contribution to existing knowledge evaluated.

7.1 Research Questions for Study 3

At the end of the previous chapter, the approach to be taken in Study 3 was outlined. The research aims focus mainly on investigating children's ability to <u>acquire</u> phonological information and the phonological processing and memory skills which might underpin such acquisition. Study 3 also explores the capacity to <u>link</u> information within a lexical representation. For example in Study 2, in order to score on the word learning assessments, children needed to have learned a phonological form such as *gauntlet* and to have <u>linked</u> this with the meaning they had acquired about the word e.g. that it was a *long glove.*

The research questions to be addressed in Study 3 are therefore as follows:

1. Do children with SLI have problems <u>acquiring</u> and retaining new phonological forms?
2. Do children with SLI have problems <u>linking</u> two pieces of lexical information (in Study 3, a proper noun and a common noun) and in retaining such links?

3. Do children with SLI have phonological processing and phonological memory problems?
4. Is there a relationship between the acquisition of new phonological forms and phonological processing and memory abilities?

To address these research questions the literature was reviewed to identify appropriate experimental tasks and materials. The rationale for the eventual choice of tasks along with the main features of the tasks used in Study 3 will be presented in Section 7.3.

7.2 An approach to the study of phonological learning and lexical linking (research questions 1 and 2)

In Study 3, the first two questions were addressed using modified paired associate learning tasks. These were based on an experimental paradigm favoured by researchers interested in the relationship between phonological short term memory and word learning (Baddeley, 1993; Baddeley, Papagno, & Vallar, 1988; Papagno & Vallar, 1992). In these studies, lists of word pairs were presented to the participant. Following this paired association, the task was to recall the second word when presented with the first.

<u>Acquiring and retaining new phonological forms</u>

A paired association task involving real words paired with <u>nonwords</u> lends itself well to the study of <u>phonological learning</u> because it is a task that is sensitive to differences between subjects with impaired phonological memory and controls (Baddeley,1988; Baddeley,1993). Importantly the skills required in paired associate learning tasks share common features with those for acquiring new vocabulary. According to Papagno & Vallar (1992) both require association. When learning new vocabulary the association is between an unfamiliar phonological form, and an object, picture or some meaning, whereas in the nonword paired association task the association is between an unfamiliar phonological form and a familiar word.

Of particular interest to Question 1 is the focus this task allows on the acquisition of the phonological form while removing demands to deduce new meaning from context, or to remember an unfamiliar meaning, such as was the case in the study by Gathercole and Baddeley (1990).

In the paired association task used in Study 3 however, there was also a requirement to link the new phonological form with a familiar word.

The longer-term retention of the phonological form was tested by asking individuals to recall the second item (the nonword) when presented with the first, a week later.

<u>Learning and retaining new links between pieces of verbal information</u>

The question of whether children with SLI have problems with Lexical Linking can also be addressed using a set of paired associations but involving familiar words. As there is no new phonological form to be acquired nor any meaning to be deduced, the main requirement in this task is to link lexical information. The longer-term retention of the <u>link</u> can be tested by asking individuals to recall the second item of the paired association a week later.

The detail of these tasks is described in the Method for Study 3 in section 7.5

7.3 An approach to investigating phonological processing and phonological memory

The third research question asks whether children with SLI have phonological processing and phonological memory deficits. Metsala (1999) defines phonological processes as "those that require cognitive operations on the sound system of a language" (p.3). As already mentioned in Chapter 1 section 1.7.3, problems with phonological processing have been observed in children with a variety of speech and language difficulties and in children with reading difficulties (Bird & Bishop, 1992; Constable, Stackhouse, & Wells, 1997; James, Vansteenbrugge, & Chiveralls, 1994; Lewis & Speake, 1998; Snowling, van Wagtendonk, & Stafford, 1988; Stackhouse, 1993; Wagner & Torgensen, 1987).

Furthermore phonological memory deficits have also been documented in language impaired children (Gathercole & Baddely, 1990; Montgomery, 1995).

This research is important because it has alerted us to some of the cognitive processing deficits which may be implicated in children's word learning difficulties. However it is also necessary to consider how such deficits might fit into a model which might underpin the <u>acquisition</u> of a new phonological representation, a process which is part of learning a new word. Such a model may draw upon existing models of single word recognition such as that of Ellis and Young (1988) or of speech perception such as that described by Bishop (1997b). This is reasonable if we assume that a model of speech perception or of word recognition might share some processes with a model of acquisition. However whereas perception may be sufficient for recognising words for which children already have phonological representations, the processes involved in speech perception described by Bishop (detection of sounds, discrimination of sounds and classification of sounds) do not in themselves seem adequate for acquisition. Accordingly, the acquisition of a new word must require an additional component over and above that described in models of speech perception.

The role of phonological memory in word learning is fully described in Baddeley et al. (1998) and in the literature review. Given the evidence for the role of phonological memory in vocabulary learning, it seems reasonable to add this area of cognitive processing to the model of speech perception in order more fully to investigate the processes possibly responsible for the acquisition of new phonological forms. Bishop (1997b) also raises the possibility that difficulty in speech perception and/or phonological memory may be implicated in problems establishing a long-term phonological representation. She states "The crucial question is whether weak vocabulary in children with SLI reflects problems in forming new phonological representations and if so, whether this is a consequence of deficient perceptual analysis at an earlier stage, or a more specific impairment in the memory system that is specialised for vocabulary learning" (p.91).

In Study 3 the investigation of phonological processing will include the initial stages of speech perception (as described in Bishop, 1997b), and phonological memory. The components are as follows:

Speech perception

- detection of sounds
- discrimination between sounds
- classification of sounds.

Phonological memory.

In the sections which follow, the evidence for deficits in speech perception and phonological memory in children with SLI will be reviewed. Then the approach taken in Study 3 to the assessment of these areas of cognitive processing will be described.

7.3.1 Speech perception: Detection of speech sounds

Adequate hearing to detect sounds of all frequencies is required. A hearing loss is an unlikely deficit in the children with SLI included in Study 3 because the majority, if not all of them, would have had their hearing thoroughly investigated pre-school. In any case, therapists referring children were asked to exclude those with permanent hearing loss. The control children will also have undergone routine screening tests and teachers were also asked to exclude children with permanent hearing loss from these groups. No assessment of hearing was therefore carried out in Study 3.

7.3.2 Discrimination between sounds

Children need to be able to distinguish between the different sounds of their language (auditory discrimination) to recognise words and it seems possible that this skill might also be important for word acquisition. According to Montgomery (1995), if children have problems with auditory discrimination this might lead to poor quality or incomplete phonological representations.

Auditory discrimination has been investigated in children with speech and language difficulties and also in children with dyslexia (a group who may overlap with the SLI population). Studies have used a variety of techniques and stimuli. Results have been conflicting and may reflect differences in the age of participants, type of difficulty studied, choice and number of stimuli and the nature of the assessment task, as well as group differences in auditory discrimination.

7.3.2.1 Auditory discrimination in children with SLI

A number of studies have identified problems with speech discrimination in children with speech and language difficulties. For example Bridgeman & Snowling (1988) reported that the perception of phoneme sequence in a group of 12 children with articulatory dyspraxia was poor for nonwords but not real words. James et al. (1994) compared auditory discrimination in a small group of language disordered children aged 8;6-10;8 years who had central auditory processing difficulties (CAP) with two groups of children with normal language, one matched for chronological age and another for language age. The children with CAP had poorer auditory discrimination for simple real words than both control groups and poorer nonword discrimination than their age matched controls. Bird & Bishop (1992) found that children with phonological disorders were poorer at discriminating between pairs of real and nonwords than peers matched for age and non verbal ability. However there was considerable variation in the impaired group, and seven of the 14 children scored close to ceiling levels. Elliot, Hammer, & Scholl (1989) used a sophisticated procedure with synthesised speech to test children's ability to detect minimal differences between phoneme pairs e.g. /pa/ /ba/. The ability to make such fine grained discriminations was significantly poorer in children who were receiving special provision for their language impairments compared with children who did not require such help.

In other studies, children's speech sound discrimination has been studied to identify a possible role in poor nonword repetition. Here findings have tended to refute rather than confirm problems in children with SLI (Edwards & Lahey, 1998; Gathercole & Baddely, 1990). And even though a study by Montgomery (1995) provided some support for poor auditory discrimination in SLI, problems were only evident on four syllable words. Consequently errors may have been due to memory rather than discrimination difficulties.

7.3.2.2 Auditory discrimination in children with reading difficulties

It also relevant to consider the literature on auditory discrimination difficulties in children with specific reading difficulties since a number of children with SLI also experience reading difficulties and because there may be an area of overlap in the two populations. In a study by Adlard & Hazan (1998) a subgroup (about 30%) of children with reading difficulties had speech discrimination problems for contrasts where sounds had low acoustic salience. Masterton, Hazan, & Wijayatilake (1995) studied a group of dyslexics' speech discrimination using the Wepman test and found that children whose performance was considered inadequate according to Wepman's criteria, were more likely to have nonword reading scores outwith the normal range. Inspection of the individual data however showed that the majority of children had scores which could be considered adequate and that in all the children errors occurred mainly on the /f/ /θ/ and /v/ /ð/ distinctions.

In short, the evidence for speech discrimination problems in children with reading difficulties and/or SLI remains equivocal. In fact it may even be that some children's earlier difficulties resolve prior to testing. However given the uncertain state of our knowledge about speech discrimination difficulties in children with SLI, and the possible importance of this skill for word learning, it is appropriate to investigate auditory discrimination in Study 3.

7.3.2.3 Assessment of auditory discrimination

The main considerations in devising a test of speech sound discrimination are the choice and number of stimuli, and the procedure for presenting these.

Stimuli

Stimuli used in auditory discrimination tasks have varied from simple syllables such as pairs of consonant-vowel-consonant words or nonwords (Gathercole and Baddeley,1990) to pairs of nonwords up to four syllables in length (Montgomery, 1995). Length is not the only relevant variable. Bridgeman & Snowling (1988) found that nonword but not real word stimuli were sensitive to discrimination difficulties in children with speech disorders compared to reading age matched controls. Adlard & Hazan (1998) found that discrimination errors occurred in certain conditions and that particular phoneme contrasts were more error prone than others. For example in the consonant cluster discrimination test, the word pairs *smack/snack* and *still/spill* were associated with significantly higher error rates. In the intervocalic consonant discrimination test, the experimental group made significantly more errors on stop consonants (but not other consonants) than either of the control groups.

When choosing stimuli it is also important to avoid confounding speech discrimination with memory. In the study by Montgomery (1995) referred to already, children with language problems only discriminated poorly between pairs of four syllable words which arguably could have reflected memory limitations as much as discrimination. Similarly Bishop, Byers Brown, & Robson (1990) found that in young people with cerebral palsy, discrimination of the same consonant contrasts varied with the procedure used. For example on a judgement task involving pairs of nonwords and where there was a greater phonological memory load, the experimental group performed more poorly than controls. On a the word judgement task (using the same contrasts) where the requirement was to decide whether the pronunciation of the name of a picture spoken by the tester was correct the experimental group had no problems.

The design of an assessment of speech discrimination should therefore include items most likely to be sensitive to discrimination errors and as far as possible those which do not confound discrimination with memory. Based on the literature it can be concluded that the items which are most likely to be sensitive to discrimination errors are those including:

- phoneme sequence change e.g. /ts/ versus /st/
- intervocalic stop consonants differing by one feature of pronunciation e.g. /aba/ versus /apa/
- consonant clusters /sm/ versus /sn/ and /sp/ versus /st/

Presentation

The presentation of the task also requires careful consideration. Locke (1980) criticises many commonly used procedures for investigating speech discrimination. In tasks where children are asked to decide if two spoken words are the same or different, children may not understand the concept of same and different. Young children might find it hard to attend to non-word stimuli because they are meaningless and uninteresting. These concerns were taken into account when designing the auditory discrimination tasks for Study 3.

Three tests of auditory discrimination were devised for Study 3 based on the items and procedures adopted in the studies by Adlard & Hazan (1998), Bird & Bishop (1992) and Bridgeman & Snowling (1988), but with considerable modifications.

The first test, Phoneme Sequence Discrimination, was based on the work of Bridgeman and Snowling (1988). These authors asked children to listen to 15 pairs of one-syllable real words and 15 pairs of one-syllable non-words in two conditions and indicate whether the words in each pair were the same or different. In one condition (segment change), the words in each pair differed by the final phoneme e.g. *loss/lot* or *voss/vot*. In the other condition, (sequence change) the words in each pair differed in the sequence of the last two phonemes e.g. *lost/lots* or *vost/vots*. The first test of auditory discrimination devised for Study 3 only assessed phoneme sequence change because in the study by Bridgeman and Snowling (1988) the children's scores were at ceiling on the segment discrimination task.

The items were also based on those used by Bridgeman & Snowling (1988). However a few of the individual items were changed in Study 3 for various reasons including the need to take account of differences between Scottish and English pronunciation. (Scottish speakers pronounce /r/ in word final blends while many English speakers do not. This meant for example that the pair of words *past/ parts* spoken by Scottish speakers differed on more than phoneme sequence and had to be replaced). In addition, some of the real word pairs were changed to include more familiar items. This was because the vocabulary age matched control group were likely to be younger than the reading age controls in the original study and therefore would be more likely to treat unfamiliar real words as non words. However as in the sequence condition in the original study all the test items involved preserving or transposing the phoneme sequence /ts/.

The presentation of the assessment described by Bridgeman and Snowling was also modified for Study 3. In their original study, these authors simply presented children with the word pairs and asked them to indicate if they were the same or different. In Study 3 it was felt that the younger vocabulary-age matched controls might have difficulty attending to the nonword stimuli in particular. Therefore to make the task more motivating, the children were asked to judge whether one character could copy the words spoken by another. This presentation was loosely based on the task described by Bird and Bishop (1992) who used two puppets but was altered in Study 3 to include a boy and a space creature. This was considered more appropriate for the wide age range of children included in Study 3. This presentation also avoided the problem of some children having difficulty understanding the concepts of 'same' and 'different'.

The essence of the second test of auditory discrimination (segment discrimination) was also to judge whether two nonwords were the same or different. However in this test children decided whether there was a change in a segment within one of the nonwords for example *aga/ada*. Although the items were derived from the task used by Adlard and Hazan (1998), the manner of presentation was very different. Unlike in Adlard and Hazan's study where children listened through the right side of headphones to carefully recorded pairs of words and indicated whether these were the same or different, in Study 3 the presentation was live, and involved the boy and the space creature described in the task above. In addition, the number of items in Study 3 was considerably reduced by including only those pairs of items most sensitive to discrimination difficulties and far fewer trials. In some conditions in Adlard and Hazan's study children were presented with 160 trials. In contrast, in Study 3, a total of 30 pairs of words was used because it was considered that younger or more distractible children would only could cope with a limited number of items.

In addition to the two tests of auditory discrimination described above a third test, Pronunciation Judgement of Real Words, was devised. This was included because the two tasks described above using judgement of 'same/different' pairs may be confounded by limited memory capacity for new phonological material (Bishop et al., 1990).

This method of assessing auditory discrimination was based on a procedure described by Locke (1980b) and subsequently used by Bishop et al. (1990). In it, the child decides whether the name of a picture spoken by the examiner is correctly or incorrectly pronounced. Consequently the child only has to retain one word in memory instead of a pair of words as in the previous assessments. To make the task more interesting in Study 3 the space creature was used and children were asked to judge whether he could say words correctly. Items tested a mixture of phoneme sequence change and segment change but the presentation reduced the memory load.

The three tests of Auditory discrimination adapted for Study 3 allowed both changes in individual phonemes and changes in phoneme sequence to be assessed. Furthermore by including two different paradigms in assessment, children were tested using tasks which varied in their phonological memory requirements.

The detail of the three tasks' presentation is described in the Method for Study 3, section 7.5

7.3.3 Classification of speech sounds

Another possibility underlying poor acquisition of phonological information is a problem with recognising familiar phonological elements across different words. Bishop (1997b) describes the classification of speech sounds as "interpreting sounds by relating them to categories based on prior experience" (p.52). Tasks assessing this skill involve both the ability to analyse a word into the subsyllabic units of onset and rime and an appreciation that words can have subsyllabic segments in common. Although described in relation to speech perception, according to Bishop (1997b) such facility is hypothesised to promote more efficient word learning because an appreciation that words can have segments in common reduces memory load for novel phonological information and allows the child to draw on existing speech motor patterns for production. Consequently this awareness allows for a more economical response to learning to produce new words. In her words "It thus becomes much easier to learn new vocabulary because once the component sounds in a word have been identified, the child can work out how to produce the whole word in terms of familiar speech motor patterns" (p.58).

7.3.3.1 Classification of sounds in children with SLI

Difficulty on tasks assessing awareness or production of rhyme has been identified in children with phonological disorders (Bird & Bishop, 1992; Bird, Bishop, & Freeman, 1995) and in single case studies of children with speech and literacy problems (Bryan & North, 1994; Constable et al., 1997; Lewis & Speake, 1998; Stackhouse, 1993). In the study by Bird et al. (1995) the test of rhyme matching was found to be sensitive to differences between groups with phonological disorders and younger reading age matched controls beyond the age when tests of onset segmentation and matching differentiated between the groups. Similarly, rhyme production was found to be particularly poor in children with expressive phonological disorders (Bird & Bishop, 1992), in children with speech and literacy problems (Stackhouse, 1993), and in a seven year old boy with developmental word-finding difficulties (Constable et al., 1997).

If children with SLI have problems with rhyme and if we accept Bishop's assertion above, it is possible that their acquisition of the phonological representations for new words might be compromised. This position has theoretical appeal but to date the limited research on the relationship between rhyme and vocabulary development has yielded conflicting results. In Gathercole, Willis, & Baddeley (1991b) the authors did not find a significant association between rhyme detection and vocabulary development, while in a study by Avons, Wragg, Cupples, & Lovegrove (1999) rhyme detection was one of the skills which predicted concurrent vocabulary at both five and six years.

In view of the theoretical position above and the limited amount of research on the relationship between vocabulary and rhyme, it is appropriate to assess rhyme in Study 3.

7.3.3.2 Assessment of speech sound classification

Two tasks were adapted from Bird & Bishop (1992) and Bird, Bishop and Freeman (1995) to assess children's ability to appreciate common speech segments within words. One task used in Study 3, <u>Rhyme Production</u> , in which children were asked to provide words which rhymed with a word spoken by the researcher, was very similar to the task used in the Bird and Bishop (1992) study.

Th other task used to assess speech sound classification was <u>Rhyme Matching</u>. This was similar to a task described by Bird, Bishop and Freeman (1995) in which the child was required to select a picture of the item which rhymed with a word spoken by the tester, from an array of four pictures.

As in any multiple choice task, the choice of distracters is important because these can make the selection easier or harder. In the study by Bird et al. (1995) the distracters for the first seven items were not chosen to make the task more difficult. However among the choices for the last seven items there was a distracter which shared features with the <u>target</u> item e.g. for the stimulus *Pat*, there was a choice of *ham, hat, shoe* and *fish*. When considering this task for Study 3 however it was considered that the task would be more sensitive to children's difficulty if there was a distracter which shared the onset and vowel with the <u>stimulus</u> e.g. for the stimulus *man*, the choice was *pan, toys, door* and *mad*.

This task was modified still further following a small Pilot study (see section 7.4). The detail of the final form of the Rhyme Matching and Rhyme Production tasks is described in the method for Study 3, Section 7.5.2.3.

7.3.4 Phonological memory

7.3.4.1 Phonological memory and word learning

The relationship between phonological memory and acquiring the phonological forms of unfamiliar words and the occurrence of phonological memory deficits in children with SLI have already been described in detail in Chapter 1. The evidence for significant relationships between measures of phonological memory and both word learning ability and concurrent vocabulary (Baddeley et al., 1988; Gathercole & Baddeley, 1990; Gathercole, Hitch, Service, & Martin, 1997; Gathercole, Service, Hitch, Adams, & Martin, 1999; Gathercole, Willis, Emslie, & Baddely, 1992; Michas & Henry, 1994) make it appropriate to include the assessment of phonological memory when investigating the source of difficulties acquiring the phonological form of new words in children with SLI. In other words an important question for Study 3 was whether the children with SLI who had problems with word learning also had phonological memory limitations.

7.3.4.2 Assessing phonological memory

Two assessments, The Children's Test of Non Word Repetition and Digit Span were used to test phonological memory in Study 3.

Measuring phonological memory is not straightforward and some of the limitations of the use of nonword repetition for assessment have already been discussed in Chapter 1.

To recap briefly, Gathercole and colleagues (Gathercole & Baddeley, 1990; Gathercole et al., 1997; Gathercole et al., 1999; Gathercole et al., 1992) favour the use of nonword repetition as a measure of phonological memory capacity. However it has been criticised by Snowling, Chiat, & Hulme (1991) as a measure of phonological memory on the grounds that it may be confounded by both phonological input and output skills. In other

words, the act of repeating a nonword requires the child to perceive the word correctly, analyse its sound segments in order to devise a motor speech programme, retain and then articulate the word. Problems with any of these processes could result in repetition errors which then might be wrongly attributed solely to phonological memory limitations.
Some researchers have attempted to isolate phonological memory limitations when studying children with language impairment, by assessing some of the above skills separately. The thinking behind this approach was that if children with SLI do not have problems with other phonological processing skills, their non word repetition errors must be due to limitations in the phonological loop. The success of this approach in isolating phonological memory difficulties in children with SLI has been variable. Although some authors have excluded all but phonological memory in poor nonword repetition (Edwards & Lahey, 1998; Gathercole & Baddely, 1990), others have not been able to completely exclude a contribution from other phonological processing skills such as speech perception (Montgomery, 1995).

Accuracy of nonword repetition may also be affected by other factors. In a study by Gathercole, Willis, Emslie, & Baddeley (1991) the contributions of memory and linguistic factors to the accuracy of nonword repetition were evaluated independently. In 4-5 and 6 year old children accuracy of nonword repetition was affected by word length and wordlikeness. While the effect of the former was thought to implicate phonological memory, the latter was considered to reflect the role of stored lexical knowledge in supporting temporary phonological representations.

Despite the possible limitations of non-word repetition as a test of phonological memory, it was decided to include it because it is standardised (the test's standardisation was developed from a representative sample of 612 children throughout England), it has been shown to have good test retest reliability, and relationships between it and word learning and vocabulary development have already been demonstrated. However in view of the criticisms, it was also decided to supplement non-word repetition with another measure of phonological memory.

The nonword matching span task described by Gathercole et al. (1999) was considered then rejected as an additional test of phonological memory. This was because it would involve the child in another task where 'same' versus 'different' judgements of stimuli were required and was therefore very similar to the tasks used for auditory discrimination. The concern was that too many similar tasks might compromise performance through boredom or inattention. Consequently digit span was chosen as an additional measure of phonological memory because it is a measure commonly used with children (Gathercole, 1999) and has a very different style of presentation to the other tasks in the assessment battery.

Based on all the above considerations the final test battery for assessing phonological learning, lexical linking, phonological processing and memory was as follows:

Learning Tests

- Phonological Learning (Paired Association names/nonnames)
- Lexical Linking (Paired Association names/names)

Retention tests

- Phonological Learning
- Lexical Linking

Phonological Processing Tests

- Auditory Discrimination:
  Perception of Phoneme Sequence
  Perception of Speech Segments
  Pronunciation Judgement (split into two halves and administered separately)
- Speech sound Classification:
  Rhyme Production
  Rhyme Matching

- Phonological Memory:

  Digit Span

  The Children's Test of Nonword Repetition

The details of the final content and administration of these tasks are described in the main method for Study 3 sections 7.5.2.2.-7.5.2.4. However the final form of the tests described in these sections was determined following a small pilot study.

7.4 Pilot study

The main purpose of the pilot study was to identify any problems with the content or administration of the above tasks and ensure confidence in presentation during Study 3.

Five pre-school children in a University Departmental Nursery, aged 4;7-4;8 years were initially chosen to participate because the youngest vocabulary age matched controls in Study 3 were likely to be nursery age children. It was felt that any problems with the clarity of instructions or length of procedure would be most apparent by piloting the materials on this age group.

Phonological learning, lexical linking, the three tests of auditory discrimination, rhyme production and rhyme matching were piloted. The measures of phonological memory were not given to the children in the pilot study because the Children's Test of Nonword repetition is a standardised test and digit span is a commonly used procedure in intelligence tests.

Following the pilot study, the paired association tasks were shortened to improve children's motivation and attention. The shortened form of the paired association task for phonological learning was then administered to a further four children aged 4;6-5;1years who were the children of personal acquaintances of the author. The purpose of this was to ensure that the shortened form of the task did not result in ceiling effects which it did not. The final form of the paired association tasks included three items instead of four, and instead of testing the children after the initial trial, testing was not introduced until the children had heard each paired association three times.

The auditory discrimination task (perception of phoneme sequence) was also shortened to include only non word items.

Minor changes were made to the way in which the rhyme production task was presented to encourage children to respond.

Finally changes were made to some items in the rhyme matching. It will be recalled that this task required the child to identify a rhyming word (for a stimulus word) from a choice of four. The items from which the choice was to be made were constructed differently in Study 3 from the choices offered to the child in the study by Bird et al. (1995). However responses from children in the Pilot study suggested that further changes needed to made to the choices offered to prevent children focusing on the initial sound (which was the same in both the stimulus and one distracter) perhaps because this focus is a common activity in pre-school pre-literacy games. The final form is described in the Method section 7.5.2.3

7.5 Method for Study 3

Study 3 explored phonological learning, lexical linking, phonological processing and phonological memory in children with word learning difficulties. As in Study 2, these children were compared with two control groups i.e. chronological age-matched and vocabulary age-matched groups. Study 3 also investigated whether any deficits in phonological processing were associated with difficulties learning the phonological form of new words.

7.5.1 Participants

Following ethical approval from the same four education authorities as in Study 2 and approaches to 16 individual schools and two nurseries, informed consent was sought from the parents of the children who had participated in Study 2. (Information sheets and consent forms for Study 3 are included in Appendices 18 and 19)

7.5.1.1 Children with SLI

The families of all 16 children with SLI who had taken part in Study 2 gave their permission for their children to be involved in Study 3. At the time of Study 3, changes in school placement meant that the children were spread over quite a wide area of the Lothians and Fife.

Six of these children were still placed in language units, six were still involved with speech and language therapy and four children had been discharged. Because some children were no longer seeing a speech and language therapist, there was less information describing their language profiles than there had been at the time of Study 2.

The summary (presented below) of the language characteristics of the group is based on the case note information for 11 children for whom there was some up to date assessment information at the time of Study 3. However one of the five children for whom there was no recent test information had been diagnosed autistic. In the case of this child, even in the absence of up to date information, severe social communication problems were assumed to be present.

<u>Language comprehension</u>

Ten of the of children (62.5% of the total sample) still had some documented degree of general comprehension difficulty. One child who had previously had comprehension problems on the Pre-school CELF test (Wiig, Secord and Semel, 1992) was scoring in the normal range on the Test of Reception of Grammar (Bishop, 1983). It is possible that had he been reassessed on the CELF-R (Semel, Wiig and Secord, 1987), he would have scored outwith the average range and this would have raised the number of children with comprehension problems to eleven. There was no up to date information for five children (31.25%).

Receptive vocabulary

It will be recalled that to be included in Study 2, children had to score one standard deviation or more below the mean on the short form of the British Picture Vocabulary Scale. At the time of Study 3, children were reassessed on this test. Nine of the children still scored significantly below the mean, but seven children attained scores within the average range for receptive vocabulary. Four of these however were just into the normal range (85+) because their standard scores were between 85 and 87.

Expressive language

Eleven children (68.75% of the total sample) presented with expressive language problems and eight of these children (50% of the total sample) had expressive vocabulary difficulties on testing.

Phonological development and social communication skills

Again there was no up to date information for five children (31.25%). And even for children still being managed by SLTs, there was very little recent information recorded about the children's phonological development or social communication at the time of Study 3. It was assumed that therapists only commented if a child still had problems.

Continuing problems with phonology were recorded for three children (18.75%) and in the case of one of the children the difficulty was very mild.

There was information to suggest that at least six children (37.5%) had some degree of difficulty with social communication. Two of these children had severe difficulties and one had been diagnosed autistic.

An overview of the language characteristics of the group at the time of Study 3 is presented in Appendix 20. In summary, the majority of children still receiving input from speech and language therapists continued to have both receptive and expressive language problems.

7.5.1.2 Children matched for chronological age

Twelve of the original 16 children matched for chronological age and standard score on the Block Design subtest of the WISC or WPPSI were also included in Study 3. Four children did not participate because one family had moved out of the country, one parent did not reply, another refused consent and the participation of one child would have involved an unacceptably long wait until her age level again matched her peer with SLI.

Informed consent was therefore obtained from a further 12 families not previously involved in the research and from these, four additional children matched for age and their standard score on Block Design were identified.

7.5.1.3 Children matched for vocabulary age

Only two children from Study 2 were included as vocabulary-age matched controls in Study 3. Informed consent was received for 13 of the original 16 children but 11 of these no longer matched the children with SLI for vocabulary age when tested. One of the original 16 children had moved away.

New vocabulary-age matched controls therefore had to be identified. As in Study 2, this was quite a lengthy procedure. To cover the range of vocabulary ages required, consent was sought from children in two schools and three nurseries. Children were first screened for vocabulary age. If the child's vocabulary age on the British Picture Vocabulary Scale (short form) was within the normal range and matched one of the SLI children, the Block Design subtest of the WISC or WPPSI was administered to ensure a match for non-verbal ability before inclusion in Study 3. In order to identify 14 new vocabulary age matched controls for Study 3, a large number of children, 100 in total, were seen.

As in Study 2, most of these children were excluded from Study 3 because they did not fulfil the criteria for a match e.g. exactly the same equivalent age for receptive vocabulary on the short form of the British Vocabulary Scale and a standard score for Block design within two points of the child with SLI. However children were also excluded or withdrawn if their block design or vocabulary standard scores were outwith the normal range or if speech or language difficulties were detected. In addition, one child who fulfilled all the criteria was withdrawn from Study 3, because his behaviour was very immature and he was unable to cope with participating.

The average and range of ages for the three groups of children in Study 3 are displayed in Table 7.1. As in Study 2 the VAC group were on average considerably younger than the children with SLI. The range in the VAC group is very large and two years greater than the age range in the other two groups.

Table 7.1 Ages of Children in Study 3

	SLI	VAC	CAC
Mean	8;11	6;3	8;11
Median	8;11	5;9	9;0
Range	80-134 months	50-129 months	79-135 months

SLI = Specific Language Impairment, VAC =Vocabulary-age matched controls and CAC =Age -matched controls.

7.5.2 The Assessments

There were 13 assessments, divided into vocabulary tests, paired association tests, recall tests, assessments of phonological processing and tests of phonological memory. The complete experimental procedure was administered over three sessions with a week between each, except where the BPVS had already been used to identify matched controls.

7.5.2.1 Vocabulary Tests

Two vocabulary tests were administered:

- British Picture Vocabulary Scale (BPVS), Short form to determine the level of receptive vocabulary.
- The Graded Naming Test (Snowling and Stothard, 1998). This unpublished test of naming vocabulary consists of 20 black and white pictures of nouns including a number of polysyllabic items such as *stethoscope* and *binoculars*. The test has normative data for children aged 3 years to 11 years. A child's raw score can be compared with the average score and standard deviation for a particular age range.

The vocabulary tests were administered before the experimental tasks. The BPVS was used to identify matched controls for the VAC group and to confirm that children in both control groups were within the normal range for receptive vocabulary. The SGNT was included as an additional measure of vocabulary to identify children (particularly in the SLI group) who might still have a vocabulary deficit despite having a score within the normal range on the BPVS.

7.5.2.2 Learning Tests

To study phonological learning and lexical linking, the children participated in two paired association tasks. In addition, one week after each learning task, the children were asked to recall the paired associations that had been 'taught'. The learning assessments were as follows:

- Phonological Learning (Paired Association names/nonnames)
- Lexical Linking (Paired Association names/names)
- Phonological Learning (retention)
- Lexical Linking (retention)

<u>Phonological Learning and Lexical Linking.</u>

Phonological learning and lexical linking were assessed using a paradigm based on paired association tasks described by Baddeley (1993), Baddeley, Papagno, & Vallar (1988) and Papagno & Vallar (1992). This task in which participants are presented with pairs of words e.g. *balloon, flower* (Gathercole et al. 1997) was adapted for Study 3 by pairing <u>pictures</u> of people and animals with <u>names</u> in the lexical linking task, and with <u>nonnames</u> in the phonological learning task. For example in the lexical linking task the child was shown a picture of a postman and told "The postman is called Thomas". It was felt that this made the paired association of words <u>postman</u> and <u>Thomas</u> more natural and meaningful.

Originally, four paired associations were presented in each paired association task (phonological learning and lexical linking). However this was reduced to three paired associations in each task following the Pilot study.

The stimuli were as follows:

Pictures

Set A pictures were a postman, a driver and a cowboy.

Set B pictures were a monkey, a rabbit and a giraffe.

The pictures for the Phonological Learning and Lexical Linking tasks are included in Appendix 21.

Names and Nonnames

The names used in the lexical linking task were Peter, Simon and Thomas.

The nonnames used in the phonological learning task were /sɔməl/, /paemɪs/ and /mitɔn/.

The names and the non names (which were devised to sound "namelike") had already been used in a word learning study by Gathercole & Baddeley (1990).

Set A and set B pictures were counterbalanced across the paired association tasks (names and nonnames). In other words in the phonological learning task 50% of the children were told **nonnames** for the people e.g. "The cowboy is called /mitɔn/" and 50% were told nonnames for the animals e.g. "The giraffe is called /mitɔn/" . In the lexical linking task 50% of children were given **names** for the animals e.g. "The rabbit is called Thomas" and 50% were told names for the people e.g. "The postman is called Thomas". In each statement the paired association was between the words underlined.

There were 10 trials during each of which the three paired associations was presented once. Each trial had a *presentation* phase in which a picture and the paired association statement were presented. After all three paired associations had been presented, there was a *test* phase in which the child was asked to recall the name or nonname when told the person or animal and shown the picture e.g. "What was the cowboy called?" The *test* phase was only included from the third to the tenth trial.

There was also a slight modification to the first trial. After each paired association had been introduced, the child was asked to repeat the name (or nonname) after the experimenter to ensure that they could pronounce it correctly. If the child's repetition was inaccurate, the experimenter said the name or nonname again until the child's repetition attempt was correct.

Within each trial there was a different fixed random order of presentation.

The children were given the opportunity to learn the names on one occasion and the nonnames on another occasion, separated by a week. The order of presentation of names and non-names was counterbalanced across children.

On the phonological learning task the child was told the following:

"I'm going to show you some pictures and tell you their names. They're funny names but listen carefully because I'll ask you them later."

The tasks were audio recorded and accuracy of recording responses and scoring checked after the experimental session. A score of two was awarded for each completely correct attempt. A score of one was given if the child's attempt had 50% of the sounds present and in the correct order. Zero was scored if the child was totally unable to recall the name or nonname, used another name/non name or if less than 50% of the sounds were present and in the correct order. Incorrect responses compatible with a persisting phonological disorder were not penalised. As in the study by Gathercole & Baddeley (1990) if children produced the correct paired associations for all the items on two consecutive trials they were judged to have reached criterion and the task was discontinued. As in Papagno & Vallar (1992), full marks were attributed to all trials thereafter.

Recall of names in the lexical linking task and of non-names in the phonological learning task was tested one week after the learning trial in which they were introduced. Pictures were presented in random order and the children were asked "What was the postman called?" etc. Scoring was the same as in the initial learning trials. Recall tasks were also tape recorded to ensure accuracy of scoring.

The test forms for both paired association tasks are included as Appendices 22 and 23

7.5.2.3 Phonological Processing Tests

The phonological processing tests consisted of three tests of auditory discrimination: phoneme sequence, segment and pronunciation judgement; and two tests of speech sound classification: rhyme matching and rhyme production. The stimuli were presented live. In all three auditory discrimination tasks the researcher covered her mouth to eliminate visual clues from production of the sounds.

Phoneme sequence discrimination

The phoneme sequence task asked the child to judge whether two spoken 'words' were the same or different. The phonemes which were altered in their sequence were /ts/ at the end of words e.g. *vost/ vots*. Following the pilot study this task was shortened to include only nonword items. There were 15 items in the test, 10 pairs of different words and five pairs with the same words. Same and different pairs were randomly ordered. The test was presented to the child as follows:

"I've got two pictures here. This one is a space creature who came here in his spaceship from up in the sky. He met a boy called Shaun. This is Shaun. The space creature is teaching Shaun to talk like him. Lets see if Shaun can copy what the space creature says! The space creature (hold picture up) said .... Shaun (hold picture up) said......
Did Shaun copy it/say it the same?"

Four practice items with feedback were followed by the test items.

The test form for auditory discrimination of phoneme sequence is included as Appendix 24.

Segment Discrimination

The segment discrimination task had exactly the same format as the sequence discrimination task. The stimuli were different however and were derived from the work of Adlard and Hazan (1998) to include judgement of the similarity or otherwise of individual phonemes (segments) within nonwords e.g. */aba/, /apa/*.

The stimuli were 30 pairs of nonwords, 15 testing discrimination of intervocalic consonants e.g. /aga/,/aka/ and 15 testing sound substitution within clusters e.g. /stɪg/,/spɪg/. The same vowels as those in the study by Adlard and Hazan were used because the vocalic context in which the consonant occurs affects acoustic salience.

There were 20 pairs where the words were different and 10 where the words were the same, divided into sets A and B with a short break between sets. In Set A there were seven items which tested discrimination of intervocalic consonants and eight which tested cluster substitution. In set B there were eight which tested discrimination of intervocalic consonants and seven which tested cluster substitution. Items were randomly distributed within each set.

The children were given the same instructions as for the phoneme sequence discrimination task, and four practice items with feedback preceded the test items. The test form for auditory discrimination of segment change is included as Appendix 25.

Pronunciation Judgement (Real words) Discrimination

In addition to the tests described above using pairs of non words, an auditory discrimination test using single real words and nonwords in a judgement task was included in Study 3. This was because auditory discrimination using 'same/different' pairs may be confounded by weak phonological memory (Bishop et al., 1990).

This method of assessing auditory discrimination was based on a procedure described by Locke (1980b) and subsequently used by Bishop et al. (1990). In it, the child decides whether the name of a picture spoken by the examiner is correctly or incorrectly pronounced.

The stimuli included 15 pictures. The name of each was said twice, once correctly and once incorrectly giving 30 items in total. The test was broken into two sections. Items were randomly distributed across the two sections. However the same word did not appear twice in either section.

The same kind of contrasts as in the previous two tests of Auditory Discrimination were tested although not in the same number. In the Pronunciation Judgement test, five of the items had the intervocalic consonant altered e.g. *'teddy/tetty'*, five had the second phoneme of a consonant cluster altered e.g. *'spider/stider'* and five had the phoneme sequence altered e.g. *'toast/toats'*. The other 15 items were correct. The stimuli included one, two, and three syllable words. The following instructions were given to the children :

"The space creature has been learning some words all by himself. Sometimes he says them right and sometimes he still makes mistakes. I'll show you a picture and tell you what he said. Say "yes" if he said the name of the picture right and "no" if he said it wrong."

Three practice items with feedback were followed by the test items. The test form for auditory discrimination pronunciation judgement is included as Appendix 26.

Rhyme Production

This task was based on the work of Bird and Bishop (1992). The main adaptation in Study 3 was that, rather than presenting the children with items which were all real words, a mixture of real and nonwords were used. Nonsense words were included to prevent children using previously learned responses as rhymes for a particular word.

Children were asked to produce three words which rhymed with each of five monosyllabic real words e.g. *'bin'* and five monosyllabic nonsense words e.g. *'nog'*.

After some demonstration and discussion about rhyme, children were given the following instructions;

"Now that you know what rhyme is, I'm going to say some real words and some funny words to you and you have to tell me some words that rhyme. They can be real words or made up words. See if you can think of three for each one."

Following four practice items with feedback the children were given 10 test items in a fixed random order.

Rhyme Matching

In the rhyme matching task the child was asked to find a picture from a choice of four which rhymed with a word or nonword spoken by the researcher. There were three real words and two nonwords and three trials for each resulting in a test with 15 trials. The presentation of the task in Study 3 was quite similar to that described by Bird et al. (1995) except that words and nonwords were used without saying that they were puppets' names and there was also one more test item. The main difference between rhyme matching in Study 3 and the above study was in the construction of the distracter items (when these were used to increase the difficulty of the task). This difference was relevant to the last nine test items in Study 3. In each of these, there were four items from which the child was required to make a choice. Two of these choices shared a segment in common with the stimulus, one distracter had no sounds in common with the stimulus and the correct choice shared two segments, i.e. the whole rime with the stimulus. This is different from the Bird et al. study where the distracter shared common segments with the target item. It is also different from the version of the rhyme matching test used in the Pilot study where there was only one phonetically similar distracter which shared the initial consonant and vowel with the stimulus. An example of an item from the final version for Study 3 is as follows: for the stimulus item *pear*, the choice was *bear, face, hat, car*. It can be seen that the correct choice shares the whole rime segment with the stimulus, *bear*, i.e. *pear*. However if children are not making a judgement based on rhyme they might choose car, which shares the /r/ with *pear* or *face* which has the same vowel as pear.

In Study 3 the child was shown a strip of four black and white pictures and told that he/ she was to find the picture which rhymed with the word spoken by the researcher .

The researcher pointed to each item and named it. For example:

" Here we have box, toys, door, leg Which one rhymes with fox? Fox rhymes with? "

Following the four practice items with feedback, the 15 test items were administered.

The items in each trial were arranged so that the position of the correct choice and the distracters was determined randomly in each array of four. Test forms for the Rhyme Matching and Rhyme Production Tests are included as Appendices 27 and 28.

7.5.2.4 Phonological Memory Tests

Two tests of phonological memory were used in Study 3, the Children's Test of Nonword Repetition and Digit Span.

The Children's Test of Nonword Repetition (CnRep)

Each child was tested on the CnRep test (Gathercole, Willis, Baddeley, & Emslie, 1994) which requires them to repeat a series of 40 nonwords, 10 at each syllable length of two to five syllables. The words conform to the pronunciation and stress patterns of English. The test includes items such as *ballop*, *diller*, *hampent*, *skitticult*, and *woogalamic*. In keeping with the space creature theme in the other assessments, children were told that they were going to learn to speak space language by repeating words after the researcher. After two practice items, the 40 nonword stimuli were presented live with the researcher's mouth covered. In the standardised form of the test, the words are presented on a tape to the children who are then asked to repeat them. However some other researchers have also presented the words live (Bishop et al., 1999; Bishop, North, & Donlan, 1996; Gathercole et al., 1997). A live presentation was considered appropriate in Study 3 because as Bishop et al. (1996) suggested, it is easier to focus the attention of young children (such as some of the vocabulary age matched controls) if the speed of the presentation is controlled by the examiner.

Children's attempts at nonword repetition were scored live but also tape recorded and checked after the experimental session to ensure accuracy of scoring. Errors compatible with an existing phonological disorder in the SLI group or phonological immaturity in any of the groups were not penalised.

Digit Span

In Study 3, digit span was assessed as follows: Starting at a sequence of two digits, children were asked to repeat a set of three trials this length. If the child succeeded on all three, the list of digits to be recalled was extended by one item and the same procedure followed. If a child made more than one error in the three trials at any length, testing was discontinued. If however the child made a mistake on only one of the trials, a fourth list at that length was presented. If this was passed, the child was given the next longer sequence and the same discontinuation criteria applied. Span was the maximum length at which a child correctly recalled three lists. This procedure for assessing digit span was taken from that described in Gathercole et al. (1997). However although these authors tested digit span on two separate occasions and calculated the average digit span over the two assessments, in Study 3 digit span was only tested once. This was because there were a number of other tests administered on each occasion and there was a concern that younger children could not sustain attention if too many tests were included in the same session. The test form for Digit Span is included as Appendix 29.

7.5.3 Procedure for administering the task battery

The seven tests of phonological processing and memory were organised into two sets, Set A and Set B. This was necessary because the procedure would have been very lengthy if all the tests had been administered on one occasion. Some assessments also had a very similar presentation and it was therefore better to separate these tests into different sets which would be administered on different occasions.

The tests in Set A were Auditory Discrimination (phoneme sequence change), Rhyme Production, Digit Span and half of the items from the Auditory Discrimination task (Pronunciation Judgement). The tests in Set B were Auditory Discrimination (segment change), Rhyme Matching, Digit Span, and the other half of the items the Auditory Discrimination task (Pronunciation Judgement). The order in which the tests were administered in Set A and Set B was systematically rotated across children. Also 50% of children were tested on Set A assessments first while the other 50% of children were tested on Set B tasks first.

The Paired Association tasks were also counterbalanced across children and sessions with 50% of the children presented with the Nonname Paired Association (phonological learning) task first, and the other 50% presented with the Name Paired Association task first (lexical linking).

The experimental paradigm was completed over three sessions of approximately 30 minutes each. In the first session, the vocabulary tests (except where the British Picture Vocabulary Test had already been used for matching) and the first Paired Association task were administered. A week later in Session 2, recall of the paired associations from the previous week was followed by the other Paired Association task. Thereafter either Set A or Set B phonological processing and memory assessments were administered.

A week later in Session 3, recall of the paired associations taught in session 2 was tested, followed by the other set of phonological processing and memory tests. An example of the test format for one child is displayed in Table 7.2.

Table 7.2 Example of Test Format for Study 3.

Week 1	Week 2	Week 3
• Vocabulary Tests (BPVS and GNT) • Phonological Learning: Paired Association (Nonnames)	• Retention of nonnames • Lexical Linking: Paired Association (Names) • Digit Span • Auditory Discrimination (sequence change) • Rhyme Production • Auditory Discrimination (pronunciation judgement, part1)	• Retention of names • Children's Test of Nonword Repetition • Auditory Discrimination (segment change) • Rhyme Matching • Auditory Discrimination Test (pronunciation judgement, part 2)

For two children, Sessions 2 and 3 were separated by more than a week due to absences from school. In one case, the sessions were separated by eight days and in another by 11 days.

7.6 Results

The results of the vocabulary tests are presented first. As stated, the main purpose of the vocabulary tests was to ensure that children in the control groups scored within the normal range and that children in the VAC group matched the children with SLI for equivalent age score exactly on the BPVS. In Table 7.3. it can be seen that the SLI group match the VAC group exactly for equivalent age on the BPVS, but that they have an average equivalent age level three years behind that of the age matched controls. The average standard score of both control groups is well within the normal range while the average standard score of the SLI children is more than 1.5 standard deviations below the mean.

On the GNT, the average raw score of the SLI children is slightly less than the VAC group and six points below the CAC group. This suggested that the SLI group were poorer than the CAC group at naming pictures but quite similar to the group matched for receptive vocabulary.

Thus at the time of Study 3 as a group the children with SLI had poor receptive and expressive vocabulary development.

Table 7.3 Children's vocabulary scores in Study 3

	SLI	VAC	CAC
BPVS			
Equivalent Age (months)			
Mean	**78**	**78**	**114**
Median	**75**	**75**	**114**
Range	**48-146**	**48-146**	**75-146**
Standard Score			
Mean	**77**	**103**	**105**
Median	**74**	**101**	**103**
Range	**42-115**	**86-131**	**87-125**
SGNT			
Raw Score			
Mean	**10**	**11**	**16**
Median	**10**	**11.5**	**17**
Range	**4-16**	**4-16**	**13-19**

The remaining results address the research questions for Study 3 which were as follows:

- Do children with SLI have problems acquiring and retaining new phonological forms?
- Do children with SLI have problems linking and retaining lexical information?
- Do children with SLI have phonological processing and phonological memory problems?
- Is there a relationship between phonological learning and phonological processing and memory?

As in Study 2, data analysis was carried out on a personal computer using Minitab Release 11 statistical software and SPSS Version 10.0. Because of the skewed distributions, nonparametric statistical analyses were carried out. Planned pairwise comparisons of the SLI and CAC groups were conducted using one tailed statistical tests because it was predicted that the CAC group would have higher scores than the SLI group. The SLI and VAC groups were compared using two tailed statistical tests because there was no specific expectation that one group would perform better than the other.

7.6.1 Phonological learning and retention

The first question asked whether children with SLI had problems learning and retaining new phonological forms. Results from the nonword paired association learning task (phonological learning) were therefore compared across the three groups in the following ways:

- Firstly the SLI and both control groups were compared for the amount of the words' phonological forms learned <u>in the course of</u> the nonname paired association task. (It will be recalled that the child was required to acquire the pronunciation of three words in each of eight trials. Each word had a possible score of two giving a score of six per trial and a possible total score of 48 across the eight test trials.)
- Secondly the groups were compared with respect to the number of children who reached criterion <u>in the course of</u> the nonname paired association task (i.e. produced all three non names correctly on two consecutive trials).
- The groups' retention of the nonwords <u>one week later</u> was also compared. For each of the three words there was a score of two, and thus a possible total score of six.

<u>Phonological learning</u>

The three groups were compared for the amount of the words' phonological forms learned <u>in the course of</u> the nonname paired association task. The age matched controls (CAC group) had a much higher median score than the children with SLI or the younger VAC group. Somewhat surprisingly, the children with SLI had a higher median score than the VAC group. The most variability occurred in the VAC group. Boxplots were drawn to illustrate these features. In Fig 7.1 (as in other boxplots presented in this chapter), the area within the box represents approximately the middle 50% of the data (the interquartile range) and the horizontal lines across the box, the median. The vertical lines projecting from the box are the whiskers. These extend to the adjacent values, scores which are furthest away from the median but still within the fences (Coolican, 1995). The inner fences are defined as one step (equal to 1.5 times the interquartile range) beyond the quartiles (Marsh, 1988). Asterisks indicate outliers, individuals whose scores are extreme and fall outwith the inner fences.

Fig 7.1 Boxplots of Phonological Learning (Paired Association, Non names)

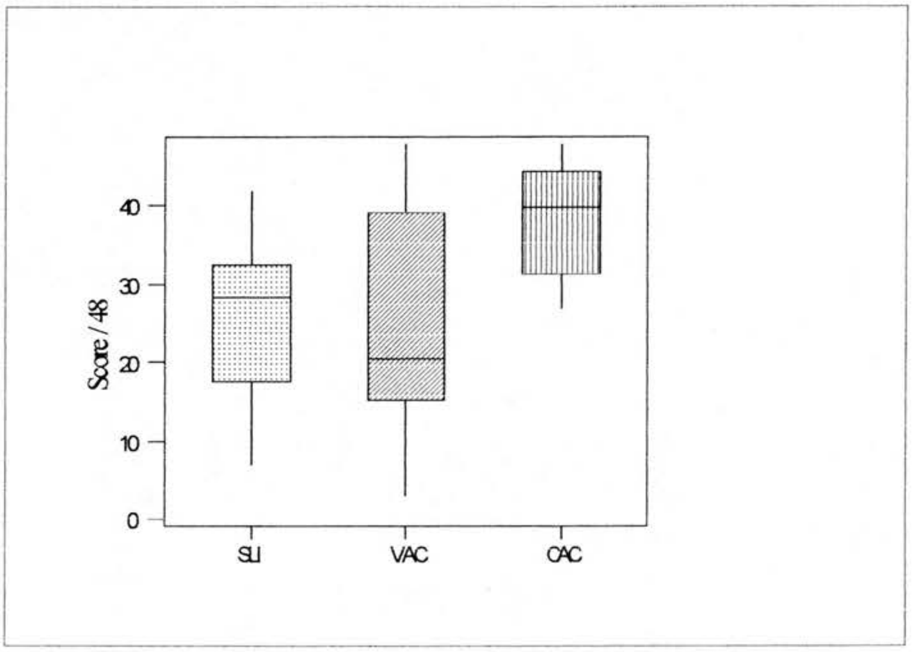


Table 7.4 displays descriptive statistics for each group on the non-name paired association task (phonological learning). A Kruskal-Wallis test confirmed that there was a significant difference among the three groups (p=0.002).

Table 7.4 Comparison of the three groups on Phonological Learning (Kruskal Wallis One-way Analysis of Variance)

Non name paired association (Phonological Learning /48)			
	SLI	**VAC**	**CAC**
MedianScore	28.5	20.5	40.0
(Range)	7-42	3-48	27-48
df =2 **H**=12.12 **p**=0.002 (adjusted for ties)			

Planned pairwise comparisons between SLI and CAC groups (Mann-Whitney-U, one tailed), and between SLI and VAC groups (Mann-Whitney-U, two tailed) showed that the SLI group was significantly poorer than the CAC group (W=175.5, p=0.0004) but that the difference between the SLI and VAC group was not significant (W=271.5, p=0.79).

Phonological learning criterion

While the scores of overall learning presented above provide information about how much of the nonwords' phonological form was learned when all eight trials were added together, this score obscures the number of children in each group who produced all three words correctly in two consecutive trials. Children who did so achieved the learning criterion and it seems reasonable to suggest that these children were more efficient or faster learners than those who never learned all three words to criterion. Furthermore their learning, at least in the short term, would appear to be more stable.

It was particularly interesting to see whether the children in the SLI and VAC groups differed in this respect given that the difference between their total median score was not significant. The number of children achieving criterion in the SLI and VAC groups is presented in Table 7.5.

Table 7.5 Children reaching or failing to reach the phonological learning criterion

	SLI	VAC
Reached criterion	0	5
Failed to reach criterion	16	11

A Chi Square test suggested that the groups were significantly different with regard to the number who attained the learning criterion, (Chi-Sq=5.926, df = 1, p=0.015).

Retention of phonological information

The results when all the three groups were compared for their retention of the nonwords one week later are presented in table 7.6.

Table 7.6 Comparison of retention of new phonological forms in the three groups. (Kruskal Wallis One way Analysis of Variance)

Retention of new phonological forms /6			
	SLI	**VAC**	**CAC**
Median score	0.5	1.0	2.0
Range	0-4	0-5	0-6
df =2 **H**=1.58 **p**=0.453 (adjusted for ties)			

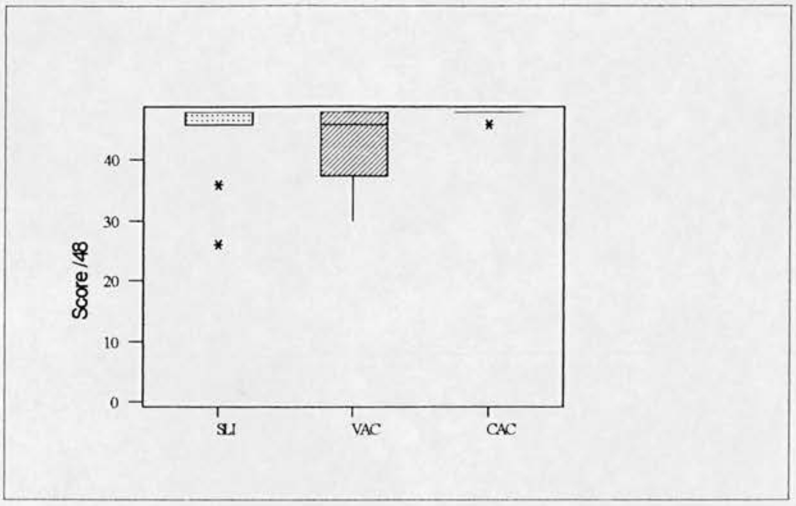
All groups performed poorly on this task with a number of children in each group failing to remember any nonwords at all. Descriptive statistics are displayed above in Table 7.6. Although the CAC group had a higher median score than both the SLI and VAC groups, a Kruskal-Wallis Test suggested that the difference among the groups in the ability to retain the phonological form of the novel words was not significant,($p=0.453$).

7.6.2 Lexical linking and retention

The second research question in Study 3 asks whether the children with SLI have difficulty associating two pieces of familiar information in word learning (lexical linking), and whether they had problems in retaining such links. Therefore the same type of comparisons between the three groups was made as for phonological learning. This included a comparison of the total score for links learned <u>in the course of</u> the paired association task (out of 48), the number of children reaching criterion within the groups, and the retention of links <u>one week later</u> (out of a possible 6).

Characteristics of the data are evident in the boxplots in Figure 7.2. These show that the task was easy for all groups with the exception of one or two individual children, marked as * on the plots. These children's scores were substantially different from the rest of the group and are described as outliers.

Fig 7.2 Boxplots of Lexical Linking (Paired Association Names)



Descriptive statistics and the results of a Kruskal-Wallis One Way Analysis of Variance are displayed in Table 7.7. Although the median scores of the three groups for Lexical Linking were very similar, the Kruskal-Wallis Test indicated that there was a significant difference among them (p=0.001).

Table 7. 7 Comparison of the three groups on lexical linking (Kruskal Wallis One-way Analysis of Variance)

	Lexical Linking /48		
	SLI	**VAC**	**CAC**
Median Score	46	46	48
Range	26-48	30-48	46-48
df=2 **H**=13.84 **p**=0.001 (adjusted for ties)			

Planned pairwise comparisons again suggested that the difference between the SLI and CAC groups was significant in the lexical linking task (Mann Whitney U, one tailed W=198.5, p=0.0013). The difference between the SLI and VAC groups was not significant (Mann Whitney U, two tailed W=288.5, p=0.34).

Lexical linking criterion

The SLI and VAC groups were compared to see whether there were differences in the number of children reaching the learning criterion on the lexical linking task, despite the similarities on the overall scores. As with phonological learning, the children who were able to provide all three correct names on two successive trials were considered to have reached the learning criterion.

In both groups there were far more children who reached the learning criterion on lexical linking than on phonological learning. In particular, while no child with SLI had achieved this for the nonword paired association task, the majority reached criterion when real words were used. The results (see Table 7.8) were entered into a Chi Square analysis. Unlike the phonological learning task, there was no significant difference between the SLI and VAC groups in their ability to learn real word paired associations to criterion (Chi-Sq=0.237, df= 1, p=0.626).

Table 7.8 Children Reaching or Failing to Reach the Learning Criterion for Lexical Linking

	SLI	VAC
Reached criterion	14	13
Failed to reach criterion	2	3

Retention (Lexical Linking)

The results for the retention of lexical links are displayed in Table 7.9. Although the SLI children had the lowest medians for retention of names in the paired association task one week later, there was no significant difference among the groups (Kruskal-Wallis One Way Analysis of Variance).

Table 7. 9 Comparison of the three groups on retention of Lexical Links (Kruskal Wallis One way Analysis of Variance)

Retention of lexical links/6			
	SLI	**VAC**	**CAC**
Median score	2.5	4.0	4.0
Range	0-6	0-6	0-6
df=2 **H**=0.45 **p**=0.798 (adjusted for ties)			

7.6.3 Summary of the learning and retention measures

The children with SLI were significantly poorer than other children their age at phonological learning and lexical linking. This suggests that they have difficulty in acquiring new phonological forms and in linking components of the lexical representation.

There was no significant difference between the SLI and the VAC groups on these tasks. This suggests that children with SLI as a group are only as good as children three years younger than them at acquiring phonological information and at linking information in the lexicon. Furthermore, despite similarities in the amount of phonological information acquired by these two groups overall, there were more children in the VAC group who reached the learning criterion (i.e. all three nonnames correct on two consecutive occasions). This may suggest that comparison on the total score alone masks the greater number of children whose phonological learning may be more efficient in the VAC group compared with the SLI group.

There was no significant difference between the groups in the retention of phonological learning (non names) or of lexical links (real names).

7.6.4 Subgroup analysis

At the time of Study 3, seven of the children with SLI obtained BPVS standard scores within the normal range. This raised the possibility that some of these children had vocabulary deficits which had resolved. However it will be recalled that all children in

Study 3 were also assessed on an expressive vocabulary test. When these scores were inspected, three of the above seven children had scores for naming vocabulary more than one standard deviation below the mean. This left four children who scored within the normal range on both the receptive and expressive vocabulary tests. Because it was possible that the scores from these four children were influencing the results of comparisons between groups, comparisons including the learning and retention measures were made using scores from the 12 children with SLI who still had vocabulary deficits on at least one test and their matched controls. Analyses of these results however using Kruskal-Wallis One Way Analysis of Variance and the Mann Whitney-U test showed that the pattern was the same whether the full group or the subgroup was used.

7.6.5 Question 3 Phonological processing and memory

Question 3 asked whether children with SLI have phonological processing and memory problems. Therefore the seven tests of phonological processing, including auditory discrimination, speech sound classification and phonological memory were compared across the groups. Results are presented for each group of tests.

7.6.5.1 Auditory discrimination

In each of the three auditory discrimination tests children were required to either judge whether a pair of spoken nonwords were the same or different in their phoneme sequence or in an individual segment within the word, or whether a word had the correct pronunciation or one that was different. Auditory discrimination errors could only be identified on the *different* items. However it was necessary to include 'same' items in the tests to have a mixture of 'yes' and 'no' responses. Also by including items which were the same, children whose responses were random or unreliable could be identified and if necessary excluded.

Across the groups, children were mainly accurate in identifying the *'same'* pairs or words that were *'the same as'* the correct form. And although all three groups made occasional errors, the median number of correct responses to *'same'* items did not differ between the groups on any of the three tasks.

Results are presented for the *'different'* responses for each of the three tests. To control for random or repeated judgement effects during the tests a 'correction for guessing' formula (Bridgeman & Snowling, 1988) was applied to the data as follows:

$$\frac{\text{(number correct-number incorrect)}}{\text{n-1}}$$

where n = the number of response choices, in this case two (yes/no)

Figures 7.3 to 7.5 display the data from the three Auditory Discrimination tests as boxplots. (A description of the boxplot as a means of displaying data was given in section 7.6.1).

The tasks for which the results are displayed as boxplots are as follows:

- Phoneme sequence discrimination in which children had to decide whether the sequence of sounds /ts/ varied or stayed the same at the end of pairs of nonwords e.g. *vost/vots.*
- Segment discrimination which asked children to decide whether a segment within a word was altered or stayed the same in pairs of nonwords e.g. /aga/, /ada/.
- Pronunciation Judgement in which children judged whether the pronunciation of a word naming a picture was correct or not e.g. *forets* for *forest*

The higher median scores (see Table 7.8) of both control groups are apparent particularly on discrimination of phoneme sequence and of speech segments. Ceiling effects were evident in the age and vocabulary-age matched children and therefore the data for the normally developing children was particularly skewed.

Fig 7.3 Boxplots of Auditory Discrimination (Phoneme Sequence)

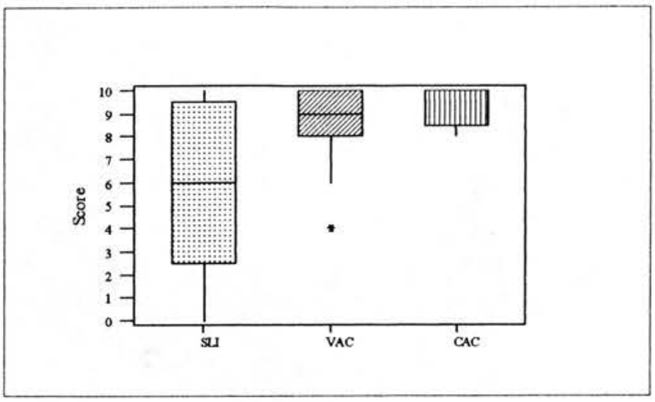


Fig 7.4 Boxplots of Auditory Discrimination (Speech Segments)

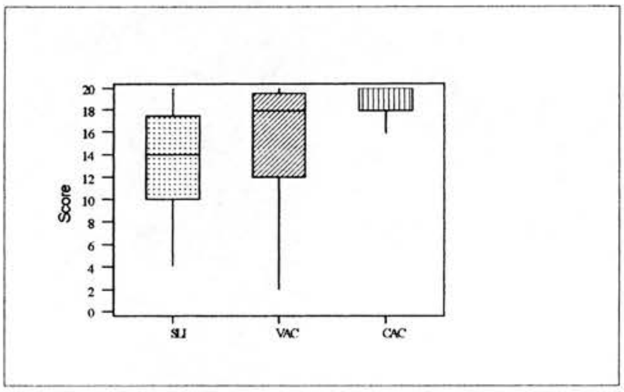
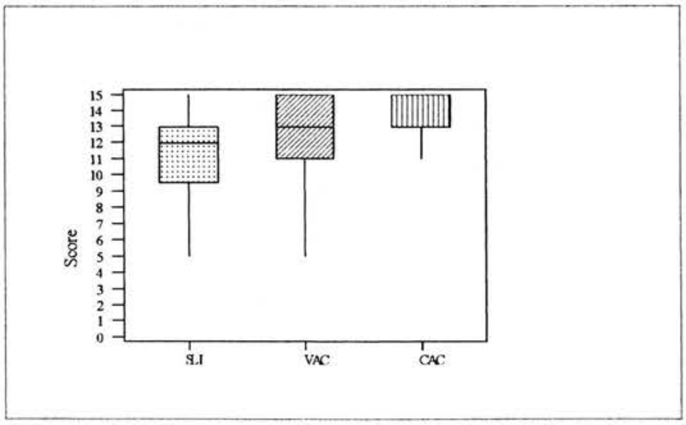


Fig 7.5 Boxplots of Auditory Discrimination (Pronunciation Judgement)



Descriptive and inferential statistics for the three auditory discrimination tests are presented in Table 7.10. Children with SLI had the lowest median scores on all three tests. As the data were not normally distributed on any of the Auditory Discrimination tests, the Kruskal-Wallis One Way Analysis of Variance tests were carried out to reveal whether differences in the medians were significant. These showed that there was a significant difference among the groups on all three discrimination tasks viz. phoneme sequence, $p=0.001$; speech segment, $p=0.000$; and pronunciation judgement, $p=0.018$.

Table 7.10 Group Comparisons on Three Tests of Auditory Discrimination: (Different judgements)

	SLI	VAC	CAC
	Phoneme Sequence /10		
Median (Range)	6 (-2-10)	9 (4-10)	10 (8-10)
	df =2 **H**=13.78 **p**=0.001 (adjusted for ties)		
	Segment Discrimination /20		
Median (Range)	14 (4-20)	18 (2-20)	20 (16-20)
	df =2 **H**=15.4 **p**=0.000 (adjusted for ties)		
	Pronunciation Judgement /15		
Median (Range)	12 (5-15)	13 (5-15)	15 (11-15)
	df =2 **H=8** **p**=0.018 (adjusted for ties)		

Planned pairwise comparisons using Mann Whitney-U tests (one tailed) suggested that the SLI group were significantly poorer than the CAC group on sequence discrimination ($W=180$, $p=0.0004$), segment discrimination ($W=163$, $p= 0.0001$), and pronunciation judgement ($W=193$, $p=0.0026$). The difference between the SLI and VAC group (Mann Whitney-U test, two tailed) was significant for the sequence discrimination task ($W=200$, $p=0.013$) and approached significance on the segment discrimination task ($W=218.5$, $p=0.085$). The difference between these groups on the pronunciation judgement discrimination task was not significant ($W=233$, $p=0.235$).

7.6.5.2 Speech sound classification

There were two speech sound classification tasks, rhyme matching and rhyme production. Figures 7.6-7.7 display the data from both tasks as box plots. The distributions are skewed and there are ceiling effects particularly in the CAC group. The variation in scores is greater in the SLI and VAC groups than in the CAC group. The children with SLI have lower median scores than both control groups (see Table 7.11). There are outliers, marked as *, one in the VAC group on rhyme matching and two in the SLI group on rhyme production.

Fig 7.6 Boxplots of Rhyme Matching

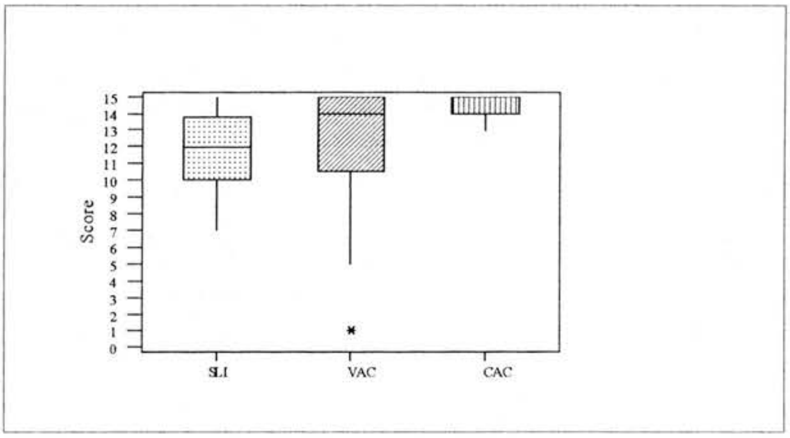
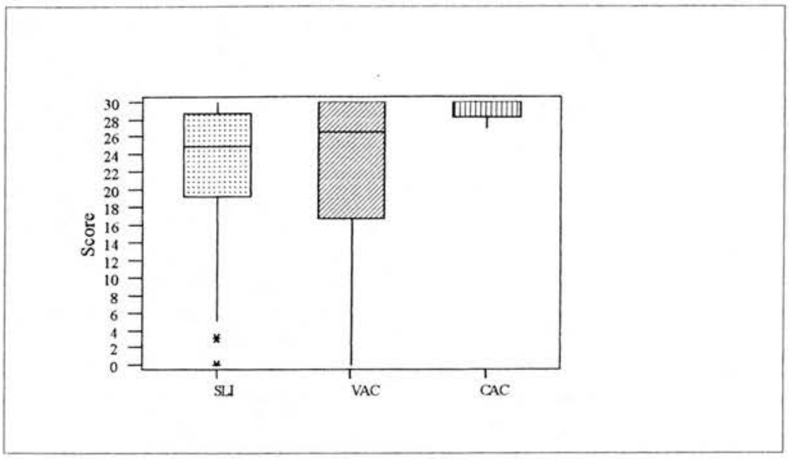


Fig 7.7 Boxplots of Rhyme Production



Inferential and descriptive statistics are displayed in Table 7.11. The limited range in the CAC group reflects their competence on both these tasks. The large range particularly on rhyme production in the other two groups shows the variability within each of them. The difference among the groups was significant on both tasks Kruskal-Wallis One Way Analysis of Variance (see Table 7.11).

Table 7.11 Group comparisons on two tests of speech sound classification

	SLI	VAC	CAC
		Rhyme Matching /15	
Median (Range)	12 (7-15)	14 (1-15)	15 (13-15)
		df = 2 **H** =12.72 **p**=0.002 (adjusted for ties)	
		Rhyme Production /30	
Median (Range)	25 (0-30)	26 (0-30)	30 (27-30)
		df = 2 **H** = 14.58 **p**= 0.001 (adjusted for ties)	

Planned pairwise comparisons showed that the children with SLI were significantly poorer than the CAC group on the rhyme matching and rhyme production tests (Mann Whitney-U test, one tailed, W=168, p=0.000, W=165, p=0.000, respectively). The differences between the SLI and VAC groups were not significant on either the rhyme matching or the rhyme production tests (Mann Whitney-U test two tailed W=229.5, p=0.193, W=251, p=0.635, respectively).

7.6.5.3 Phonological memory

The groups' scores for phonological memory, as assessed by the Children's Test of Nonword Repetition and Digit Span, were compared. Boxplots of the data are presented in Figures 7.8-7.9. The difference between the three groups' median scores on Nonword Repetition is very apparent.

Fig 7.8 Boxplots of Nonword Repetition

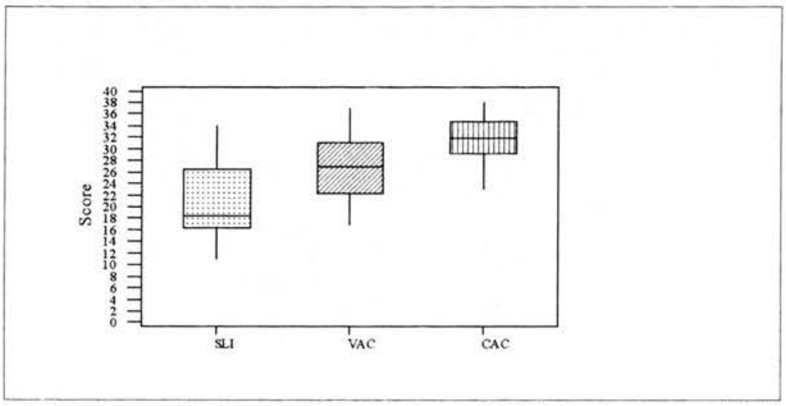
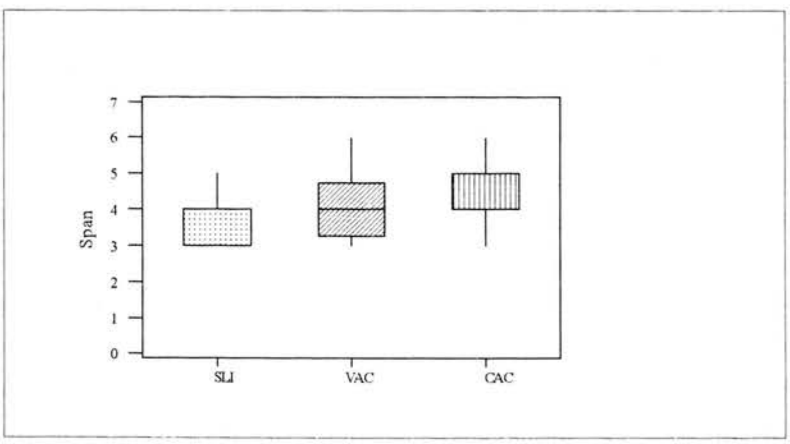


Fig 7.9 Boxplots of Digit Span



The SLI group had a much lower median score on the Children's Test of Nonword Repetition than either control group (see Table 7.12). A Kruskal-Wallis test confirmed that the difference among the groups was statistically significant (p=0.000).

The difference among the groups for Digit Span was also statistically significant. (Kruskal-Wallis p=0.031). These results are displayed in Table 7.12.

Table 7.12 Group comparisons on two tests of phonological memory

	SLI	VAC	CAC
		Nonword Repetition /40	
Median (Range)	18.5 (11-34)	27 (17-37)	32 (23-38)
		df = 2 **H**=18.87 **p**=0.000 (adjusted for ties)	
		Digit Span	
Median (Range)	4 (3-5)	4 (3-6)	5 (3-6)
		df = 2 **H** = 6.93 **p**=0.031 (adjusted for ties)	

Planned pairwise comparisons between the SLI and CAC groups (Mann Whitney-U, one tailed) and between the SLI and VAC groups (Mann Whitney-U, two tailed) confirmed that the children with SLI were significantly poorer than the CAC group on Nonword Repetition (W=162, p=0.000) and Digit Span (W=201, p=0.007). The difference between the SLI and VAC groups was significant for Nonword Repetition (W=199, p=0.014) but not for Digit Span (W=250.5, p=0.59).

7.6.5.4 Subgroup comparisons

The above analyses of phonological processing and memory were repeated using only the subgroup of children with SLI (n=12) referred to in Section 7.6.4. These were children who scored at least one standard deviation below the mean for either expressive vocabulary, receptive vocabulary or both. Children whose scores at the time of Study 3 were within the normal range on both tests were not included in the subgroup. The pattern of results in the subgroup was similar to that in the full group. That is on all the tests of phonological processing and memory the children with SLI were significantly poorer than the CAC group (Mann Whitney-U test, one tailed; sequence discrimination, W= 107, p=0.003; segment discrimination, W=91, p=0.000; pronunciation judgement, W=100.5, p=0.0014; rhyme matching W=89, p=0.0002; rhyme production W=86.5, p=0.0001; nonword repetition, W=91,p=0.0004; digit span, W=110, p=0.0077).

When compared with the VAC group, (Mann Whitney-U test, two tailed) the SLI children were only significantly poorer on Nonword Repetition (W=114, p=0.0397 although they came close to being significantly poorer on Auditory Discrimination of Phoneme sequence, (W=120.5, p=0.08).

7.6.5.5 Summary of phonological processing and memory tests

The above set of analyses investigated whether children with vocabulary deficits from Study 2 had problems with phonological processing and memory. The results from between group comparisons on the various measures used in Study 3 suggested that these children were poorer than those matched for age on every measure of phonological processing and memory. Their performance on a number of assessments was no better than the VAC control group who were much younger. Furthermore on two measures, nonword repetition and auditory discrimination of phoneme sequence, the SLI group was even poorer than the younger control group. The results therefore suggest that children with SLI have considerable difficulty with tasks involving phonological processing and memory. Their problems with perceiving changes in phoneme sequence and on nonword repetition were particularly marked.

7.6.6 The relationship between phonological learning and phonological processing and memory.

The fourth research question in Study 3 considered whether there was a relationship between children's performance on the phonological processing and memory tasks and their phonological learning on the Paired Association task using nonnames.

In each group, the strength of the association between the scores from the phonological processing and memory tasks and the scores on the nonword learning task was calculated taking the effect of age into account in the following way. Firstly a resistant line was drawn (for the association between age and each experimental task). The stored residuals (i.e. the scores remaining with age taken into account) were ranked, and the association between the variables was tested using the nonparametric Kendall's Correlation Coefficient. This was chosen in preference to the parametric alternative, the Pearson Product-Moment correlation coefficient, because it does not assume a normal distribution of the data, and in preference to Spearman's rank correlation because it deals more consistently with data in which there are tied ranks (Robson, 1993). All correlational analyses were two-tailed.

Correlation coefficients are presented in Table 7.13 for each group separately. Correlations between the measures of phonological processing and memory and non-name learning were weak and many were negative. The strongest associations with Nonname learning occurred for Rhyme Matching in the SLI group, and for Rhyme Matching and Rhyme Production in the CAC group. In the SLI group this correlation coefficient was close to significance ($p=0.078$). In the CAC children the association between rhyme production and the ability to learn nonnames was highly significant ($p<0.01$).

Table 7.13 Kendall's Correlation Coefficients: Phonological Learning (PL) and Phonological Processing and Memory

	AD1	AD2	AD3	Rhyme Match	Rhyme Prod	Digit Span	NonWord Repetition
PL (SLI)	-.027	.067	.174	.329	.025	-.161	.252
PL (VAC)	-.221	-.051	-.119	-.051	-.051	-.136	-.119
PL (CAC)	-.017	-.151	-.017	.256	.685**	.134	.153

** $p<0.01$ AD = Auditory Discrimination. AD1(Phoneme sequence). AD2 (Sound Segment) AD3 (Pronunciation Judgement)

In summary, in Study 3 (with one exception), measures of phonological processing and memory in children with SLI and controls were not significantly associated with the ability to acquire new phonological forms.

7.7 Discussion of Results from Study 3

The research questions for Study 3 were as follows:

- Do children with vocabulary deficits have problems <u>acquiring</u> and retaining new phonological forms?
- Do children with vocabulary deficits have problems <u>linking</u> two pieces of lexical information (in Study 3, a proper noun and a common noun) and retaining lexical information for naming?
- Do children with vocabulary deficits have phonological processing and memory problems?
- Is the acquisition of new phonological forms related to phonological processing and memory abilities?

In this section of Chapter 7, the results of Study 3 will be discussed with reference to each research question in turn.

7.7.1 Phonological learning and retention

The results from the measure of total phonological learning in Study 3 suggested that as a group, children with SLI continue to have difficulty acquiring new phonological forms. Their performance on the non-name paired association task was considerably and significantly poorer than children who were the same age and it did not differ significantly from younger children matched for level of receptive vocabulary. There was a suggestion indeed from the learning criterion findings that, despite having a lower median score than the children with SLI, the VAC group might include more children whose learning was more efficient and stable, at least in the short term.

These results confirm the notion raised in Study 2 that learning new phonological forms is a problem for these children. In addition it concurs with work of Dollaghan (1987) and Haynes (1982) who also found that children with SLI had problems of this nature. However unlike in Study 2 and the work of Haynes, the children with SLI did not differ significantly from the VAC group in the amount of phonological information acquired. It is therefore necessary to consider what might explain these different results.

One suggestion is that children with SLI had less severe phonological learning difficulties than they did at the time of Study 2. This would not be surprising if one assumes that the ongoing intervention which many children with SLI received between Study 2 and Study 3 was beneficial. It will be recalled that at the time of Study 2, 13 of the children with SLI were in Language Units and all were known to the Speech and Language Therapy service. Although between Study 2 and Study 3 the number placed in language units declined to six, many of the group with SLI in mainstream education were still receiving specialist help for their language difficulties, either outreach teaching, speech and language therapy, or both. Because all the SLI group had had a significant difficulty with vocabulary as the main criterion for their inclusion in Study 2, it seems reasonable to assume that some of the intervention provided between Studies 2 and 3 would focus on improving this area.

In particular, the current emphasis in the literature on phonological learning deficits in relation to vocabulary (Easton, Sheach, & Easton, 1997; Hyde Wright, Gorrie, Haynes, & Shipman, 1993; McGregor, 1994; Wing, 1990) may have encouraged at least some therapists and teachers to target this area. In addition there is a concern that, as a group, children with SLI are at risk of reading difficulties (Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). Consequently teachers, particularly those in Language Units, may have focused on phonological processing skills with these children. The development of such skills are often included in reading remediation for example (Hatcher, Hulme and Ellis, 1994) and may also be helpful for developing skills to acquire the phonological representation of new words. Therefore as a result of remediation, children with SLI may have been better at phonological learning at the time of Study 3 than they were at the time of Study 2.

Alternatively the measure of overall phonological learning adopted in Study 3 may not have been sensitive enough to differences between the groups because data was based on the same 3 words and it was not possible to compare rate of learning. Certainly when learning was measured in another way, by looking at the number of children who achieved the learning criterion, a chi-square analysis suggested that there were significantly more children in the VAC group than in the SLI group who produced all three words correctly on two separate occasions.

Yet another possibility is that the results may merely reflect difficulties inherent in a research design where a clinical group is compared with a control group matched for a particular aspect of language development. Because all but one of the children with SLI had receptive vocabulary ages below their chronological age (and equivalent age for receptive vocabulary was the matching variable), the VAC control group was inevitably younger. In Study 3 the median age difference between these groups was 38 months and therefore quite large. Furthermore five individual children in the VAC group were only aged between 4;2 years and 5;0 years. The difference in age between the SLI and VAC groups means that there are likely to be differences in children's experience and attention which might depress the control group's performance and hence result in an underestimation of the skill being assessed.

This argument of course might also apply to the Naming measure from Study 2 where children with SLI *did* perform more poorly than the VAC group. However the format of the phonological learning task in Study 3 (because it was more repetitive) may have been less interesting than the contexts which introduced the new words in Study 2. As a result the younger controls may not have engaged with the learning opportunities in Study 3 as well as they did in Study 2. Consequently their scores may not have reflected their true potential for learning the sound of new words. This issue is dealt with more fully in section 7.7.3. However it is important to raise the possibility that the lack of a significant difference between the SLI and the VAC groups (and indeed the fact that the SLI group had a higher median score) may reflect a depressed performance in the VAC group due to factors other than phonological learning, rather than an improved performance in the children with SLI.

In Study 3 more long term retention of phonological learning was also studied by testing the children's recall of the non-name paired associations a week after these had been introduced. Children in all three groups were poor at producing the nonnames after a time delay. However it was surprising that there was no significant difference between the three groups when they were compared for retention of non-names particularly as the CAC group was expected to retain more non-names than the children with SLI. At first glance this result suggests that children with SLI were no different even from children the same age. However this unexpected result may be explained if we consider design aspects of the experimental paradigm.

In the non-name (and the name) paired associate learning tasks, the number of exposures given was governed by the point at which the child reached or failed to reach criterion. This meant that children who produced all three non-names (or names) correctly on two consecutive trials before the final learning trial had fewer repetitions of the paired associations because, in accordance with the work of Papagno & Vallar (1992), the learning trials were stopped when the children reached this stage. In both control groups there were a number of children (VAC n=5, CAC n=9) who had reached criterion before or by the last learning trial. Conversely no child in the SLI group did so and this meant that, unlike in the control groups, every child with SLI heard the non-names 10 times. When the data for the control groups were inspected, because of the number of children reaching criterion, only eight children in the CAC group heard the words ten times and some heard the words only six times or less. In the VAC group only 11 of the 16 children heard the nonname paired associations the full ten times. It is therefore possible that the CAC and VAC groups would have had better scores for retention if they had had as much exposure to the non-names as the children with SLI.

7.7.2 Lexical linking and retention

The second question in Study 3 asked whether children with vocabulary deficits have problems linking two pieces of lexical information (in Study 3, a proper noun and a common noun) and in retaining lexical information for naming. This was investigated because it was suggested that difficulty linking components of a lexical representation might contribute to problems with naming (see Chapter 6 Section.6.6) That is, the child might have acquired the phonological and semantic representations wholly or in part but failed to link these or to link them correctly.

The real name paired association task addressed this possibility. By using words which are individually familiar e.g. "The driver is called Thomas", the demands for learning new phonological information or a new meaning were eliminated and success was dependent on the child's ability to correctly associate the pieces of information.

The pattern of results on lexical linking was similar to that on phonological learning. Children with SLI were significantly poorer than the age-matched controls but not significantly different from the VAC group. There was no significant difference between any of the groups when retention of the paired association names were tested. These results suggest that the SLI children did indeed have some difficulty with linking components of the lexical representation although their median score (as was the case in the two control groups) was substantially better than their score for Non-Name paired association.

The lack of a significant difference between the three groups for retention of real name paired association may suggest that although the CAC group was initially better in their learning they did not retain their advantage after a week had passed. Alternatively the lack of an expected difference between these groups for recall may be accounted for by the smaller number of exposures that the children with normal language development received because they reached criterion earlier (The way in which this occurred has already been described in section 7.7.1).

7.7.3 Phonological processing and memory

The third research question asked whether children who had vocabulary deficits had poor phonological processing and memory.

The results described in section 7.6.5-7.6.5.5 were an important first step in identifying possible reasons for children's difficulties acquiring a phonological representation. In particular it was important to establish whether the impaired group demonstrated a <u>range</u> of difficulties in their phonological skills or whether their problems where confined to phonological memory as had been suggested by Gathercole and Baddeley (1990). The results of Study 3 suggested that children with vocabulary deficits did indeed have difficulty on a variety of phonological processing tasks. These results are therefore broadly in agreement with the findings from single case studies which to date have been the main methodology for assessing underlying phonological processing in vocabulary deficits in children (Bryan & North, 1994; Chiat, 1993; Constable et al., 1997; Lewis & Speake, 1998; Stackhouse, 1993). In these single case studies, all but one child had some degree of difficulty with discrimination of phonemes or phoneme sequences, and rhyme detection or production, tested in a variety of ways, was a problem for more than half of the children described. The fact that Study 3 demonstrated such difficulties in a reasonably large <u>group</u> of children with vocabulary deficits overcomes some of the difficulties with generalising results which are an inherent limitation of the single case study methodology.

Given the difficulties with phonological processing which were apparent in the children with SLI it is tempting to conclude that such problems were a cause of their difficulties with acquiring a phonological representation. However notwithstanding the fact that this cannot be concluded without additional evidence (e.g. from correlations and perhaps from intervention studies, and the difficulty in demonstrating such a relationship) the literature suggests that difficulties with phonological processing need not coexist with lexical problems. This was evident in some previous research by Bishop et al. (1990) and by Gathercole & Baddely (1990). In the first of these studies the authors found that an apparent difficulty with auditory discrimination in young people with Cerebral Palsy and speech and vocabulary deficits was no longer present when the same phoneme contrasts were tested by a different procedure (one which did not make the same demands on phonological memory). Gathercole & Baddely (1990) also did not detect auditory discrimination problems in a small group of language impaired children many of whom had vocabulary deficits when compared with a language matched control group and a group matched for non-verbal ability. The conflict between these results and those of Study 3 may be explained by the very small number (n=5) of SLI children tested in the Gathercole study, the fact that both control groups were younger than the SLI children and the possibility that the procedure was not sufficiently sensitive. Comparison between the results of Study 3 and those from the Bishop study are more problematic since the participants were much older and had speech deficits resulting from Cerebral Palsy. Moreover a true comparison of research findings on auditory discrimination can only be made when assessment procedures are standard and sufficiently sensitive, and when similar groups of participants are assessed.

It will be recalled that in Study 3 the children with vocabulary deficits were not only poor on a variety of phonological processing tasks but that they were also significantly poorer than the CAC group on both measures of phonological memory and significantly poorer than the VAC group on nonword repetition. Furthermore the magnitude of the difference between median scores on this test was considerable (8.5 points difference between the SLI and VAC groups and 13.5 between the SLI and CAC groups). The results from Study 3 therefore also extend previous investigations using single case studies because it included the assessment of phonological memory (a skill considered important for the acquisition of new vocabulary). Because the models on which single case studies were based did not include phonological memory, this was not assessed. However as the results in Study 3 indicate, children with vocabulary deficits had particularly pronounced difficulties on nonword repetition and the role which phonological memory might play in the acquisition of new phonological forms cannot therefore be ignored.

Study 3 also adds to the growing literature on phonological memory which documents difficulties with Nonword repetition in children with SLI (Bishop et al., 1996; Edwards & Lahey, 1998; Ellis Weismer et al., 2000; Gathercole & Baddely, 1990; Montgomery, 1995). In addition it specifically identifies phonological memory difficulties in a larger group of children with vocabulary deficits than in the Gathercole and Baddeley (1990) study. The finding that the SLI group were poorer than the younger group matched for vocabulary corresponds to the results from studies by Gathercole and Baddely (1990), Montgommery (1995) and also by Edwards and Lahey (1998) and seems to suggest that the nonword repetition deficits in the children with SLI are not a consequence of their poorer language levels.

The difficulty in claiming a causal relationship between these phonological memory problems and lexical deficits remains however, particularly as phonological memory deficits and vocabulary deficits need not coexist (Baddeley, 1993; Bishop, 1996). This point will be returned to in section 7.7.4. where the relationship between phonological processing and memory, and phonological learning is considered in more detail.

Further interpretation of the results from Study 3 can be assisted by considering the comparisons between the SLI and CAC groups separately from the comparison between the SLI and VAC groups.

SLI/CAC group comparison

It is theoretically plausible to argue that difficulties with phonological processing cause vocabulary deficits when one considers the poor performance of children with vocabulary deficits on these tasks compared with their peers. (Furthermore using hypothesised models of word recognition we might even speculate about how each individual processing deficit might compromise the ability to learn new words). This would not be unreasonable given that some previous research only makes comparisons between children with SLI and children the same age (Bird & Bishop, 1992; Bird et al., 1995; Elliot et al., 1989; Kiernan & Gray, 1998) and suggests a causal relationship between performance on experimental tasks and children's impaired speech (Bird and Bishop,

1992) and impaired speech and literacy (Bird et al., 1995). Furthermore, alternative explanations for the differences between these two groups in Study 3, such as age, gender or non-verbal intelligence have been ruled out by individually matching children on these variables. However when deriving conclusions from such comparisons, the difference in language levels between the SLI and CAC groups should not be ignored.

In Study 3 it will be recalled that the criteria for the CAC group also included vocabulary development within the normal range. These children therefore had significantly higher standard scores and equivalent age levels on the BPVS than those with SLI ($p<0.001$, both scores). Taking this important difference into account, an alternative explanation for the results would be that the relatively poor phonological processing in the children with SLI was secondary to, or commensurate with, their level of language development.

SLI/VAC Comparisons

The results from the VAC group when first considered, may appear to agree with the opinion that the deficits in phonological processing skills are in keeping with language level since there was no significant difference between children with SLI and this group on five of the seven measures. (Those on which there was a difference, Nonword Repetition and Auditory Discrimination of Phoneme sequence, will be dealt with separately).

Such a view would be compatible both with the general conclusion derived from comparisons with language age matched controls i.e. that no significant difference indicates a performance which is a consequence of poor language development rather than a factor which is important in causing the language difficulties. This interpretation would also be in keeping with research which specifically suggests that vocabulary development affects the ability to perform certain phonological processing tasks (Metsala, 1999; Walley, 1993).

Thus the results might be interpreted as suggesting that the poor phonological processing skills evident in Study 3 are not implicated in problems with ongoing vocabulary development in children with SLI. There are however problems with such conclusions derived from a comparison between children with SLI and language matched controls and these will now be discussed.

Although children in the VAC group were matched for non-verbal intelligence in the same way as the CAC group and also for gender, each child in the VAC group was also individually matched for exact age equivalent on the short form of the British Picture Vocabulary Scale. Because most of the children with SLI had age equivalent scores for vocabulary that were below their age, the VAC group were more than three years younger on average and the difference in age was significant ($p<0.001$).

A number of authors raise concerns about the interpretation of a finding of no difference when children with SLI are compared to a younger control group (Bishop, 1992; Bishop, 1997a; Kiernan & Gray, 1998; Plante, Swisher, Kiernan, & Restrepo, 1993). One such concern is described by Bishop, (1997). She suggests that older SLI children are likely to be more advanced in a number of areas than language matched controls, e.g. general cognitive development, attention and approaches to experimental tasks. These differences may enable the children with SLI to compensate for any underlying impairment, thus possibly masking a genuine difference. On this same note Avons et al. (1999) refer to the problems inherent in carrying out intensive testing with young children because their attention span limits performance. Furthermore Bird & Bishop (1992) suggest that use of nonwords requires children to pay attention to uninteresting and meaningless stimuli. Given that children in the VAC were younger overall, and that some of them were only four years old, these factors also need to be taken into account.

Another concern about comparison using language age matched controls is the erroneous interpretation of null findings (Plante et al., 1993). These authors suggest that "the lack of a statistically significant difference does not make two groups alike" and that furthermore

"..when the use of a language matched group has been introduced as a method of examining the role of language level, it is easy for the reader to assume an association between language level and the dependent variable when no such association exists" (p774-775). On the same subject Bishop (1997) suggests that while a better performance by the language matched controls may be interpreted as indicating that performance on the dependent variable is not secondary to language level, where there is no difference "this does not tell us much except that the impairment *could* be a secondary one." (p917). Further to the above, there is a certain circularity in an argument which suggests phonological processing skills might be important for vocabulary development but such skills are in themselves dependent on accumulated vocabulary. Such a position might be resolved as Baddeley et al. (1998) did when evaluating the relationships between existing lexical knowledge and the ability to repeat nonsense words and acquire new vocabulary. These authors draw attention to the possibility that vocabulary development and processing (in their argument phonological memory) may both play a part in learning new phonological forms. They state that it is "oversimplistic to claim that the phonological loop mediates long term phonological learning in a unidirectional manner. Instead, vocabulary knowledge, phonological loop capacity, and nonword learning share a highly interactive relationship. There is accumulating evidence that, for at least some nonwords, the task of nonword repetition taps both the phonological loop and knowledge about the structure of the native language" (p.161).

Another reason to be cautious about interpreting the lack of significant differences between the SLI and VAC groups is that there were more children in the VAC group (than in the SLI group) who scored the maximum number of points on all the tests except Digit span and Nonword Repetition. Thus the measures may not have been sufficiently sensitive in detecting differences. Testing the same processes with different measures or more extended measures may be more fruitful.

Finally it is very important not to overlook the significant differences which did occur between the SLI and both control groups on Auditory Discrimination (phoneme sequence) and Nonword Repetition. The fact that the SLI group performed even more poorly than children matched for receptive vocabulary suggests that they have a disproportionate impairment on these skills relative to their level of receptive vocabulary. This suggests that these skills may indeed play a causal role in the acquisition of the phonological form of new words.

However some caution must be exercised when making a claim that phoneme discrimination and phonological memory may be implicated in difficulties acquiring a phonological representation for new words. This is particularly in view of the controversy surrounding the purity of Nonword Repetition as a measure of phonological memory (e.g. Snowling et al., 1991) and the likely demands on memory made by an auditory discrimination task involving same/different judgements of pairs of nonwords (Bishop et al., 1990).

In the next section the association between phonological processing and phonological learning in Study 3 will be discussed. A positive and significant correlation between these skills would provide some further evidence for the role of these processing abilities in vocabulary acquisition.

7.7.4 The relationship between phonological processing and memory and learning the phonological representation for new words

One of the starting points for investigating a relationship between phonological processing and the ability to acquire phonological representations for new words in Study 3 was the single case studies in which children with vocabulary deficits were shown to have problems with phonological processing. However in the main, these case studies indicated the <u>coexistence</u> of these two problems rather than a relationship between them. Thus the methodological limitations inherent in the single case design did not allow exploration of relationships between processing and learning.

The results of Study 3 cast some doubt on whether the phonological processing deficits identified in the children were related to their vocabulary deficit because there were almost no significant correlations between the phonological learning tasks and the measures of phonological processing. Consequently the results of Study 3 may suggest a need for caution in making assumptions about the underlying deficits in children with vocabulary difficulties particularly when these are purely based on coexisting deficits.

Where group studies have investigated a relationship between aspects of phonological learning and vocabulary there has been a lack of agreement as to whether significant associations exist. Furthermore comparison with Study 3 results is complicated by differences in the variables studied and the participants. In particular much of the research has been carried out on considerably younger children than those who participated in Study 3.

There is a particular dearth of research on the relationship between auditory discrimination and vocabulary development. Some work by Bishop et al. (1990) however found a significant relationship between concurrent vocabulary (measured on the British Picture Vocabulary Scale) and Auditory Discrimination of same/different nonword pairs in a group of young people with Cerebral Palsy. However these authors also suggested that Auditory Discrimination tested in this way made demands on phonological memory. It was therefore unclear whether the reported association was purely between Auditory Discrimination and Vocabulary. In the light of the very limited research in this area, the findings from Study 3 may provide some preliminary evidence that Auditory Discrimination and Nonname learning are not associated. On the other hand the lack of association is difficult to reconcile with current models of word recognition. It is possible therefore that aspects of the methodology, or the age at which the children were assessed constrained the results.

In Study 3, the majority of analyses suggested that there was not a significant relationship between rhyme and nonname learning. The only exceptions were in the CAC group where rhyme production was significantly associated with nonname learning and there was also a trend ($p=0.078$) for rhyme matching to be significantly associated with nonname learning in the SLI data.

When viewed overall, the results are in keeping with work by Gathercole et al. (1991b) who also did not find a significant relationship between rhyme and vocabulary. However the significant association in the CAC group and the trend for a significant relationship in the SLI group may suggest a possible relationship between the ability to judge (or produce) rhyme and the capacity to learn the phonological form of new words at least in some children. This tentative suggestion concurs with some prior research in which significant relationships between rhyming tasks and performance on the Peabody Picture Vocabulary Scale were reported (Avons et al., 1999; Metsala, 1999). Furthermore, in the Avons study, cross lagged correlations showed that rhyme detection at age five years predicted later vocabulary after removing the effect of vocabulary at age five.

Finally Study 3 suggested that there was no significant relationship between Digit Span and Nonname learning and between Nonword Repetition and Nonname learning. This result was the most surprising of all. It ran counter both to studies which demonstrate a significant association between level of existing vocabulary and measures of phonological memory and those which suggest that measures of phonological memory predict or are related to the ability to acquire the phonological aspects of new words (Gathercole & Baddeley, 1989; Gathercole et al., 1997; Gathercole et al., 1999; Gathercole et al., 1991b; Michas & Henry, 1994). Two possible explanations for the discrepancy will be considered.

The first of these is that there is not a static relationship between measures of phonological memory and phonological learning throughout childhood. One important possibility is that the age of the participants determines whether an association exists and the direction of any relationship which does exist.

When Study 3 is compared with prior research in this area, it is apparent that children in the SLI and CAC groups were on average almost nine years old and those in the VAC group approximately six years old while those in the studies by Gathercole & Baddeley (1989), Gathercole et al. (1999), Gathercole et al. (1991b) and Michas & Henry (1994), were much younger and generally aged 4-5 years. If, as has been suggested (Gathercole et al., 1992), the nature of the relationship between vocabulary and measures of phonological memory changes with age (with vocabulary predicting performance on measures of phonological memory after 5 years, rather than the reverse), it is possible that phonological memory is also less important in learning new phonological forms in older children.

At first sight some work involving 13-14 year olds by Gathercole et al. (1999) appears to contradict the suggestion that there is a diminished role for phonological memory in older children's vocabulary development because these authors report a significant association between measures of phonological memory and acquired vocabulary. However firstly the authors did not apply the same stringent test of the possible causal nature of the relationship by carrying out cross lagged correlations as they did in Gathercole et al. (1992). Secondly the vocabulary development was measured on the BPVS and the Mill Hill Vocabulary Scale summed into a composite score. Since the latter assessed children's ability to provide definitions and choose synonyms, this measure does not seem particularly appropriate when postulating a relationship between phonological memory and phonological learning because success will be dependent on semantic knowledge at least as much as on phonological information.

The results of Study 3 are more in keeping with the work of Bishop et al.(1996) in which no significant relationship was found between nonword repetition and expressive vocabulary in a group of 7-9 year old children. Of particular interest was the fact that children whose language impairment had resolved were nevertheless significantly poorer than controls on nonword repetition and little different on this measure from those whose language impairment persisted. This suggested to Bishop and her colleagues that poor nonword repetition need not lead to weak vocabulary development, especially since about 25% of their sample scored very poorly on nonword repetition yet had expressive vocabulary scores that were average.

While the results of Study 3 suggest that phonological processing and memory may not be related to the acquisition of a phonological representations, it is also possible that such a relationship might have been obscured because of ceiling effects in the data. It will be recalled that a number of the measures of phonological processing (but not phonological memory) were affected by ceiling effects. The restriction in the range of scores which inevitably ensue in the case of ceiling effects is, according to Howell (1987), likely to reduce the potential correlation. Consequently some caution is necessary in interpreting the lack of correlation on the measures of processing in Study 3.

7.8 Overall conclusions of Study 3

In summary the findings from Study 3 were as follows:

- When compared with children of the same age and non-verbal ability, children with SLI had difficulty in learning new phonological representations and in linking components of lexical representations. Their performance on these tasks was only as good as children at the same level of receptive vocabulary who were on average two and a half years younger. This suggests that the word learning deficits identified in Study 2 may be partly accounted for by difficulties with phonological learning and lexical linking.
- Children with SLI also have phonological processing and memory deficits compared with age matched controls. Again their performance was not significantly different from the much younger vocabulary age controls except on one test of auditory discrimination and on Nonword Repetition. On these two measures they were significantly poorer than even the younger control group.
- There was little evidence from correlational analyses that the measures of phonological processing and memory were associated with the SLI group's difficulty in acquiring new phonological representations. This suggests that the relationship between phonological processing and memory and phonological learning, particularly in older children with word learning deficits, is not clear cut.

CHAPTER 8 THE EXTENT, NATURE AND SOURCE OF VOCABULARY DEFICITS

8. Introduction

Chapter 8 will begin by reviewing the aims of this thesis. The discussion will then consider the strengths and weaknesses of the research approach and methodology adopted in addressing the limitations of previous work in the field. Towards the end of the chapter a tentative model for the vocabulary acquisition process derived from the three studies carried out in the course of this thesis together with past research in the field will be proposed. Finally the chapter will consider the direction of future research in the area of vocabulary deficits.

8.1 The aims of this thesis revisited

This thesis investigated the extent, nature, and source of vocabulary deficits in children with Specific Language Impairment. The research which is described in it was motivated by concerns which arose in the course of my work as a Speech and Language Therapist. A principal anxiety was the lack of knowledge upon which to base effective intervention. This in turn was rooted in a lack of understanding about the nature of the problem and the underlying cognitive skills which might be deficient.

In an attempt to improve upon the current state of knowledge, vocabulary deficits were studied (Study 2) from the perspective that they were indicative of a difficulty with learning. That is, vocabulary deficits in children with SLI were considered to reflect problems with the acquisition of previously unfamiliar vocabulary. Consequently a large part of the research investigated the children's ability to learn new words. Word learning in children with language impairments has also been studied by other authors (Dollaghan, 1987; Leonard et al., 1982; Oetting et al., 1995; Rice et al. 1990). However various limitations in this research suggested that the area would benefit from further study.

The study of word learning, (Study 2), was followed by a focused enquiry into some of the cognitive processing skills considered relevant to the word learning deficits which became apparent in the course of Study 2.

8.2 Strengths of the word learning paradigm in investigating vocabulary deficits

A major part of the work in this thesis made use of an experimental paradigm to study word learning in contexts which were natural and representative of the 'real world' word learning opportunities which children encounter, but with strict experimental control. Such an approach was advocated by Gathercole (1990). As an extension of previous research studies in which characteristically only one context for word learning was explored, Study 2 included two quite different opportunities to learn words. The first of these was a Story which presented an opportunity for incidental word learning because no specific attention was drawn to the unfamiliar words and the words' meanings had to be deduced by the children from the text and accompanying pictures. The second learning opportunity was an Explicit Teaching context where words were introduced one by one and specifically defined. By studying children's total word learning (i.e. the sum of all the measures of word learning combined at Time 1 and Time 2 separately) from each of these contexts in Study 2, the research addressed the question of whether children with vocabulary deficits have word learning problems. Although this may seem self evident it was by no means certain that this would turn out to be the case. An alternative explanation was that their vocabulary deficits were due to differences in the language learning opportunities that children with SLI encounter (as a consequence of the language impairment), when compared with children who have normal language development.

Such differences have been demonstrated in opportunities that children with SLI have for social interaction. Apparently children with SLI have less scope to interact with their peers because even pre-school children are aware of language status and initiate interaction with SLI children less than they do with children who have age appropriate language (Hadley and Rice,1991). Moreover in a study by Gertner et al. (1994), children with normal language development were much more frequently nominated as children that their classmates would like to play with than those with language impairments. This in turn might limit the opportunities that children with SLI have for interacting with their peers and arguably could lead to deficiencies in their social interaction skills through lack of experience. Although the above examples relate to social communication, it is equally possible that differences in the language environments of children with SLI might also lead to decreased opportunities for learning new vocabulary.

Some children with SLI may be less able than children with normal language development to benefit from the language learning opportunities offered by joint picture book reading with a parent. In a small study of 11 language delayed children, Mogford-Bevan and Summersall (1998) evaluated videos of parent/child picture book sessions and questionnaires relating to the child's book reading habits. They found that picture book reading with children with marked receptive language difficulties was a more difficult and less rewarding experience for the child and one which occurred less frequently than for children with better language comprehension.

Certainly by the time a child goes to school, individual differences in reading ability may affect vocabulary growth. According to Nagy et al. (1987), reading plays a very important role in increasing a child's vocabulary such that an average amount of reading might contribute about one third of a child's vocabulary growth each year. Since a number of children with SLI are poor readers compared with their peers (Bird et al.,1995) this may limit their opportunities for vocabulary growth from text (Bishop, 1997).

It is reasonable to conclude then, given the examples described above, that limitations in language learning opportunities may contribute to children's poor vocabulary development. It is, however, clearly not the whole story. In Study 2 the children with vocabulary deficits and the control groups were provided with the same carefully controlled opportunities for word learning. Despite this when the groups were compared, the children with SLI had considerable difficulty in learning new words. Furthermore this was irrespective of whether they were presented with unfamiliar words in a context where attention was specifically drawn to them and their meaning defined, or whether the words occurred in a context which relied on more incidental learning.

The two explanations for vocabulary deficits, that of reduced opportunities to learn and intrinsic difficulties with learning are not however mutually exclusive and it may be in fact that one has the potential to compound the other. Therefore in intervention it may be necessary to address both. In relation to manipulating the environment, Mogford-Bevan and Summershall (1998) describe ways to encourage parents to have more fruitful book reading experiences with their children through appropriate expectations and choice of books. Intervention for the intrinsic word learning difficulties of the child also require to be addressed but this will be discussed in section 8.8.1.

While it is important to confirm that children with vocabulary deficits have word learning problems, this is not enough to gain insights relevant to intervention. In addition we need to know the <u>nature</u> and <u>source</u> of their word learning problems. In this thesis these concerns were addressed by using a two phase, sequential investigation. In the first phase, the measures of word learning from Study 2 were individually analysed to gain insights into the nature of the problem. In the second phase (Study 3) an investigation into a possible source of the problem was guided by the results of Study 2.

8.3 A theoretical starting point for the study of word learning

In the previous section, the value of a word learning experimental paradigm in the study of vocabulary deficits in children with SLI was described. To understand the nature of their problems with word learning however we must consider what information children have learned about previously unfamiliar words.

This study began from a starting point in which the role of phonological <u>and</u> semantic learning were acknowledged as important in the acquisition of new words. Consequently when children with SLI presented with vocabulary deficits there was an assumption that the nature of their learning difficulties lay in one or both of these areas. This was an important initial standpoint because it sought to address some of the limitations of previous approaches to understanding vocabulary development. However as will be seen, it required a theoretical framework from which to consider the assessment of phonological and semantic learning. In the next section, first some competing views of vocabulary acquisition and the limitations of previous approaches to understanding word learning difficulties will be considered. This will be followed by a description of the initial theoretical framework which guided the assessment process.

8.3.1 Models of vocabulary acquisition and their limitations

Currently our understanding of the vocabulary learning process remains incomplete and poorly defined. One important limitation is that researchers investigating cognitive skills in either populations of children with normal language development or in children with vocabulary deficits have tried to understand the process using rather one-sided or unbalanced perspectives of the acquisition process. That is they have tended to focus on either the process by which the word's phonology might be acquired <u>or</u> the process by which the word's meaning might be learned.

For example as a basis for exploring the difficulty which children with SLI have in learning new meanings from naturalistic contexts where no explicit attention is drawn to the unfamiliar words, Rice et al. (1990) stress the process by which <u>meaning</u> might be acquired. They suggest this involves "Identification of the new word, a quick assessment of the linguistic and non linguistic context and entering the probable meaning into the appropriate slot in the available lexicon and storage for immediate or later use" p33. The short comings of this explanation are evident firstly in the lack of detail about the way in which meaning might be derived from the linguistic and non-linguistic context and secondly in the lack of attention paid to the phonological representation. Furthermore although a possible role for syntactic bootstrapping in the acquisition of meaning in this process has been discussed by Rice et al. (2000), a full account of the process by which a semantic representation for a new word is acquired remains lacking.

The considerable research output of Gathercole and her colleagues e.g. (Gathercole & Baddeley, 1989; Gathercole & Baddeley, 1990; Gathercole, Hitch, Service, & Martin, 1997; Gathercole, Service, Hitch, Adams, & Martin, 1999; Gathercole, Willis, Emslie, & Baddely, 1992) is also one sided. Despite the fact that Gathercole's explanation of the word learning process (Gathercole, 1993) highlights the importance of referent, context and grammatical class in specifying the meaning of a word, this has not been a subject of their research. Instead the authors have focused entirely on the acquisition of the phonological representation and the role of phonological memory in this process. While this recent interest in the phonological aspects of vocabulary acquisition is important particularly because this area was neglected in the past, in itself it is not sufficient to fully explain the way in which the child acquires novel words.

Yet another approach to the study of vocabulary acquisition has come from single case studies of children with lexical deficits. Putting aside the obvious limitations of information derived from single case study methodology, it appears that some of these individual clinical accounts e.g. (Constable, Stackhouse, & Wells, 1997; Lewis & Speake, 1998) at least acknowledge the potential for both semantic and phonological processing breakdown to affect vocabulary development. For example Bryan & North (1994) and Lewis & Speake (1998) explored phonological processing skills which might be implicated in the acquisition of a phonological representation and also demonstrated that some children with vocabulary deficits have inadequate semantic representations. Despite the latter observation however, their accounts failed to explore how the semantic processing (upon which the acquisition of a semantic representation must depend) might be breaking down.

The rather unbalanced view of the acquisition process is presumably due to the fact that models of processing used to explore the children's difficulties are based on models of word <u>recognition</u> which specify a role for phonological processing in recognising a word. While it seems reasonable to assume that word recognition and acquisition share the need to process phonological material, models of recognition do not need to specify the way in which semantic information is acquired. Furthermore because word recognition does not require word learning, investigations based on such perspectives also ignore the role of phonological memory in the process of forming a long-term phonological representation for new words.

A related point is that the any causal relationship between processing and vocabulary acquisition remains hypothetical until this is demonstrated with further research Consequently it would be inappropriate for clinicians working with children with vocabulary deficiencies to assume e.g. that a deficit in the chain of phonological processing necessarily accounts for a child's lexical deficits.

The above account stresses the limitations in our current understanding of vocabulary learning. It will be apparent in the course of this discussion that the research carried out in this thesis attempted to address these limitations.

8.3.2 The <u>nature</u> of the word learning problem: What carefully designed assessments can tell us

A particular strength of Study 2 was the rigorous approach to the assessment of word learning which allowed previous research to be extended from a situation where it was unclear whether children had difficulties with learning the meanings or phonological forms for new words or whether they had problems with both.

In the course of this, the assessment of children's lexical knowledge following exposure to unfamiliar words was of paramount importance particularly as a principal aim was to establish whether vocabulary deficits were evidence of deficient phonological or semantic learning.

From the outset it was acknowledged that a major difficulty in assessment would be "tapping into" a child's phonological representation independently of the semantic representation to establish the nature of the child's vocabulary learning difficulty. It was therefore necessary to evaluate the extent to which the assessment tasks could be considered to accomplish this. Accordingly, a theoretical framework described by Ellis and Young (1988) for adult word recognition and production but used subsequently in single case studies of children with lexical deficits, (Bryan & North, 1994) was applied to the analysis of the assessment tasks.

8.3.3 A theoretical framework for the assessment of phonological and semantic learning

A model of word recognition and production was used to evaluate the assessment tasks because these sought to explore what the child <u>had learned</u> about the experimental words. In other words it was assumed that for at least some children, the experimental words would have become somewhat familiar as a result of the learning opportunities. Consequently it was appropriate to consider the demands of assessment in terms of a framework for word recognition and production, rather than one for acquisition.

For word recognition Ellis and Young (1988) describe a broadly serial process as follows; "We propose that the first stage of auditory word recognition performed by an early auditory analysis system attempts to identify phonemes in the speech wave. The results of this analysis are transmitted to the auditory input lexicon where a match is sought against the stored characteristics of known words. If the match is a good one, the appropriate recognition unit in the auditory input lexicon will be activated. It in turn will then activate the representation of the meaning of the heard word in the semantic system..." p 144. The authors also accept bi-directional effects between the auditory input lexicon and the semantic system so that the semantic context can affect the how easily a word is identified.

In word production the process begins with the semantic representation of the word which leads to the retrieval of an appropriate word which is then articulated. Their account of word production is essentially modular in which the semantic system, the speech output lexicon and the phoneme level are seen as separable and distinct cognitive components.

Other models of word recognition and production which differ from the basic models posited by Ellis and Young have also been described in the literature. For example in relation to spoken word recognition Marslen-Wilson (1989) suggests that many more words are activated than are needed, that word recognition may take place while the word is still being spoken and that listeners draw upon other information to reach their decision about the correct word meaning.

Unlike Ellis and Young's assertion that the process of word production is modular, Dell & O' Seaghdha (1992) and Roelofs (1997) suggest that it involves interaction between some or all of the representational strata in the lexicon. For example according to Levelt (1999), describing Dell's two-step interactive activation computational model of word production "semantic feature nodes spread their activation to the corresponding word or lemma nodes, which in turn spread their activation to phoneme nodes. Activation cascades from level to level over all available connections in the network" p 225. Importantly however, all of the connections are bi-directional because activation spreads both ways. This latter aspect of this model allows for the explanation of mixed speech errors, those which are both semantic and phonological in character e.g. rat for cat.

These models proposed after Ellis and Young (1988) may provide more plausible explanations of the way in which the recognition and production of spoken words take place especially when we consider the speed of the processing required, and in word recognition, the sometimes poor quality of the speech heard. However what is common to the models described is that the end product of successful word recognition is access to the word's meaning and in word production, access to the word's phonological form. And although the models described suggest different ways in which this is finally accomplished, they all recognise that in the process both phonological and semantic information is required.

Accordingly the assessment tasks in Study 2 could be conceptualised as ultimately requiring the child to 'alight' on the 'correct' semantic or phonological representation in order to be successful while acknowledging the fact that in the process both semantic and phonological knowledge were required.

8.3.4 Other strengths of the assessment of word learning in Study 2

The design for Study 2 also included a range of assessments so that the limitations of any one task in identifying a problem might be offset by the strengths of another. For example Study 2 included three assessments of semantic learning, Word Description, Meaning Recognition and Picture Comprehension. This is in contrast to the studies of initial word learning carried out by Rice and her colleagues where only a multiple choice picture comprehension test was carried out after the learning opportunity. The problem with such limited assessment of word learning is that firstly it is mainly a test of semantic learning (with no corresponding test of phonological learning), and secondly the test is not sensitive to the degree to which a word's meaning is known. For example Ralli (1999) suggests that multiple choice picture tests do not necessarily reflect the degree to which a correct or incorrect response is indicative of the individual's state of knowledge about a given word. Consequently a multiple choice picture comprehension test might not be sensitive to differences between children in their acquired semantic knowledge. In Study 2, to address this problem the range of assessments was extended to include two additional tests, one in which children were asked to provide definitions of the unfamiliar words (Word Description) and another where they were asked to answer questions about two features of each word's meaning (Meaning Recognition).

The outcome of the rigorous and relatively comprehensive assessment of word learning in Study 2 was that the nature of the word learning problem could be described with reasonable confidence. That is children with vocabulary deficits had difficulty in learning both the meaning and the phonological form of the experimental words. And this difficulty was apparent in two quite different contexts for word learning. This in turn suggests that professionals working in the education of children with SLI who have vocabulary deficits may need to stress both the meaning <u>and</u> the phonological from of new words.

8.4 How might word-learning deficits affect the growth of the lexicon?

At this point it is interesting to speculate about the way in which the word learning difficulties reported in Study 2 might affect the growth of children's lexicons. This requires consideration of children's word learning potential in conjunction with the language to which they are exposed.

Clark (1995) describes how the acquisition of word meaning may be quite protracted. However she suggests that once children have isolated the (phonological) form of a word they can then recognise the word when it occurs again. In her words "Once children have some form in memory, they can gradually adjust the information associated with it - its meaning - as they find out more about how it is used" (p.395). This account makes the assumption that the acquisition of the phonological form is relatively straightforward and cannot therefore take into account the difficulties that some children might have in acquiring this. If, as was demonstrated in both Study 2 and Study 3, children with vocabulary deficits have difficulty acquiring a phonological representation for previously unknown words then it may be that this problem constrains their ability to build up a sufficiently elaborate semantic representation. This was a view put forward by Haynes (1982) who suggested that the acquisition of word meanings in children with vocabulary deficits were compromised by their inability to lay down a phonological representation which would serve as a hook onto which meaning could be attached.

An alternative explanation is that the difficulties that the impaired group apparently had in deducing meaning from the Story context when compared with controls had an effect on how well they memorised the phonological form. In relation to this Clark (1995) also suggests that "It is possible that any meaning associated with a form helps to make that form more memorable" (p.395). The direction of the effect is therefore unclear but whatever the problem, it appears that children with vocabulary deficits need a greater variety of experiences or repetitions of new words than children with normal language development in order to learn them.

Having considered child based factors it is also important to consider how these word learning difficulties might interact with opportunities to hear unfamiliar words in the environment. It is well known that words vary in the frequency with which they are used (Gilhooly and Logie,1980; Hall et al.,1994). Consequently for some words children may have fairly ongoing and consistent exposure perhaps allowing those with vocabulary deficits to build up their lexical representations for these words albeit at a slower rate than their peers. This would be in keeping with the Time 2 data in which additional exposure to unfamiliar vocabulary resulted in a median gain of greater than zero for almost every measure of word learning in the children with SLI.

Other words may occur less frequently in the child's language environment. This may mean that such words never get enough exposure to become established. The very low median scores that children with vocabulary deficits achieved on some measures at Time 1 suggested that with an exposure rate of only six repetitions learning was very poor indeed.

In conclusion the nature of the word learning difficulties identified over the course of Study 2 together with the information from the lexical linking task in Study 3 suggests that the word learning difficulties experienced by children with vocabulary deficits are complex, and include difficulty in acquiring both phonological form and the meaning of unfamiliar words and in making links between these.

The results of Study 2 were important for two reasons. Firstly they supplied information about the nature of the children's difficulties in learning words upon which to base effective vocabulary teaching because they identified the need to emphasise both the phonological form <u>and</u> the meaning in vocabulary instruction. In this way the results provided an empirical basis for work such as that carried out by Easton et al. (1997) who described an approach to vocabulary teaching which included both phonological and semantic elaboration strategies. And this may be sufficient if the aim of remediation is to teach a limited amount of vocabulary that is, for example, central to a particular area of the curriculum. This information is not enough however when we consider the limitations of even a carefully structured programme of vocabulary teaching in keeping apace with the demands for rapid and extensive vocabulary growth from about the age of seven onwards. Such intervention would need to be based on information about the underlying skills (i.e. the source of the problem) which, if improved, would help the child become a more competent independent learner.

8.5 Exploring the sources of word learning problems

Study 3 investigated one possible source of the word learning difficulties which had been identified in the children with SLI in Study 2. This two phase approach was an extension of previous research into the source of lexical problems because unlike studies which investigated the source of vocabulary deficits without first establishing that the children had word learning difficulties, Study 3 was directly based on the results of Study 2 and was conducted with the same group of children.

Of the two types of difficulty identified in Study 2 (phonological and semantic learning) the former was chosen for specific focus in Study 3. This was because children with vocabulary deficits in Study 2 were poorer even than younger children matched for vocabulary when naming pictures of the unfamiliar words at Time 2. Since this measure was considered to differentially emphasise phonological learning, this result was taken to suggest that acquiring the phonological form of new words was the most marked area of difficulty for children with vocabulary deficits.

Study 3 investigated possible sources of the problem acquiring a phonological representation by carrying out a task in which children were required to learn new phonological forms in association with familiar words (the nonname paired association task), by investigating phonological processing and memory skills which underpin learning a new phonological form, and by looking at the relationship between phonological learning and phonological processing and memory.

In common with previous attempts to investigate the underlying processing in children with vocabulary deficits, Study 3 adopted a framework of skills which were considered important for the acquisition of a phonological representation and devised assessments accordingly. As in Study 2, considerable effort was made to devise a range of assessments which would enable differences between the groups in their phonological processing and memory to emerge.

There are two main ways in which Study 3 extended previous work. Firstly most research in this area had previously been carried out using a single case study methodology with its concomitant limitations. In Study 3 however, phonological processing skills were studied in a relatively large number of children with vocabulary deficits and compared with both chronological-age matched and vocabulary age matched controls. This meant the results could more easily be generalised. Secondly the framework used to investigate the acquisition of a phonological representation included the assessment of phonological memory in addition to phonological processing.

The results from Study 3 showed that children with vocabulary deficits did indeed have difficulty acquiring new phonological forms in the absence of any significant demands to acquire meaning. The results also suggested that they were poorer than children of the same age and non-verbal ability on assessments of phonological processing and memory. Moreover they were poorer than even the younger vocabulary-age matched controls on nonword repetition and discrimination of phoneme sequence, and only as good as them on the rest of the measures.

Somewhat surprisingly there was only one significant relationship between assessments of phonological learning and those testing phonological processing and memory and that occurred between rhyme production and nonname learning in the CAC group. This meant that the source of the children's difficulties acquiring the phonological forms of words remained obscure.

Having identified the nature of the difficulties learning unfamiliar words in Study 2 it would have obviously been desirable to uncover a relationship between phonological processing and memory and learning the phonological form of an unfamiliar word. This might have suggested that intervention which improved phonological processing and memory could lead to an improvement in children's ability to learn for themselves from incidental encounters with words as suggested by Nagy and Herman (1987). Since this was not the case, it is important to consider a range of explanations for this pattern of results which might give some indications for future research.

One possibility is that the paired association task was too restricted to be representative of the demands for phonological learning that children encounter in the real world or that other demands might have influenced children's performance on this task as much as phonological processing. These will be dealt with in turn.

In relation to the first of these the new nonnames in Study 3 were three, two-syllable words with simple syllable structures. When compared with paired association tasks in the adult literature, this was a rather limited demand since usually a greater number of paired associations were introduced. However it will be recalled that in the pilot study young children lost attention and motivation when there were four paired associations. In any event, when responses were inspected in the most able group, the CAC controls, a number of these children were making errors in the pronunciation of the nonnames. This suggested that they had not fully acquired the phonological form of some of the nonnames and that the task was therefore quite challenging, at least for some of them.

With regard to other demands in the phonological learning task it is acknowledged that it also requires children to associate the nonname with its paired association. This meant that lexical linking was also inherent in this task and may have been a source of difficulty for some children in all three groups, thereby confounding the effects of phonological learning.

Another possibility is that the assessments of phonological processing and memory were not sufficiently sensitive to detect processing constraints in any of the three groups. The reduced potential for correlation caused by ceiling effects was referred to in Chapter 7 section 7.7.4. And it was the case that in the measures of auditory discrimination and rhyme there were a number of children in both control groups who were scoring at ceiling. In addition there were also some children with SLI who were scoring the maximum on some measures although the numbers in this group were consistently smaller than in the control groups. This suggests that in future research it would be advisable to devise measures which are more sensitive and which therefore might avoid the ceiling effects which may have masked correlations. This might be accomplished if a much larger pilot study including groups of children at different ages was carried out.

The notion that ceiling effects were totally responsible for the observed lack of relationships between phonological learning and processing does not hold up when we consider in particular the results from the test of nonword repetition however. On this test there was much greater variation in scores and no ceiling effects in any of the three groups. Yet despite this, and the considerable prior research to suggest that there would be a significant relationship, none was found.

Yet another possibility is that phonological memory and phonological processing are not implicated in learning phonological representations. This seems an unlikely explanation but a more plausible suggestion might be that deficits in these skills might have differing impacts at different stages of development. Consequently it is possible that if children, particularly in the SLI group, had been tested either at the time of Study 2 or when they were even younger, such problems may have been more apparent. It may be that with the passage of time, phonological processing deficits which might have been problematic at an earlier age had resolved to the extent where they no longer played a part in children's word learning difficulties. This pattern was noted in some research by Bernstein and Stark (1985) who carried out a follow up of some children with SLI. At the time of their first assessment, these children were significantly poorer than controls at discriminating between pairs of tones with short interstimulus intervals. Four years later, despite the fact that the majority of the language impaired group could still be classified as such, the children had improved in their speech perception skills and no longer showed the deficits in discrimination they had when first assessed. The authors stated that "...considering Time 2 results alone we could not conclude that Specific Language Impairment in older children is caused by perceptual difficulties in rapid rate processing of phonemes" (p28). Although in this study (like Study 3) there was a possibility that the measures were no longer sensitive to the children's problem, an alternative explanation is that skills which may have been important at one stage of the language learning process though resolved, may still have affected the process long term. In Bishop's words "This raises the possibility that a slow maturing auditory perceptual system might leave a lasting legacy of language impairment even after ceiling levels of auditory discrimination have been reached" (p.907).

An opposite situation occurs when children' language deficits resolve yet tests of cognitive processing remain poor. In a study by Bishop et al. (1996), children with a history of speech and/or language problems which had subsequently resolved (such that their scores on language tests were well within the normal range) were tested on the Children's Test of Nonword repetition. Despite their otherwise normal language profiles, these children had an average score more than one standard deviation below control levels for nonword repetition and their performance was not significantly different from a group with persistent language impairment. Moreover there was no significant relationship between nonword repetition and a test of expressive vocabulary which raised the possibility that poor nonword repetition need not necessarily have a negative impact on vocabulary acquisition.

In summary, what these two scenarios suggest is that the relationships between underlying processing and language development are not straightforward and relationships between variables may alter with maturation and, as suggested by Bishop (1996), with the extent to which compensatory strategies are employed. Thus the lack of a significant relationship between phonological learning and phonological processing and memory may be yet one more indication of the complexity of investigating the source of lexical (and other) linguistic deficits.

8.6 Some further methodological strengths and weaknesses

The discussion so far has concerned itself with a number of the strengths and limitations of the experimental approach in this thesis. In the next section, issues related to the language measures used for identifying and matching children will be discussed followed by some consideration of the impact of the variation in the children's language profiles on the experimental results.

8.6.1 Groups of children studied

It will be recalled that in section 1.6.3.2 and section 1.6.3.3. the limitations of some previous research in the field of word learning in children with SLI were described. These included the fact that when word learning was studied in children with SLI, the groups were sometimes quite heterogeneous with respect to whether or not the children with SLI had a vocabulary deficit. It will also be remembered that some research only compared the word learning abilities of children with SLI to children of the same age and that in other studies the impaired group were only compared with children matched for language age. The difficulties associated with each of these comparisons has already been described fully in sections 7.7.3(pp 244-245).

In an attempt to address the above short comings all the children with SLI identified for this thesis had a vocabulary deficit defined as a standard score on the British Picture Vocabulary Scale (Dunn et al., 1982) of at least one standard deviation below the mean. This was a criterion similar to that used by Rice et al. (1990) and Oetting et al. (1995) in their studies of children's Quick Incidental Learning. Furthermore the word learning performance of the children with SLI was compared both to children matched for age and to a group matched for receptive vocabulary development.

Thus in the research carried out in this thesis the British Picture Vocabulary Scale (BPVS) was used for the following main purposes:

- In Study 2 it was used to identify SLI children with vocabulary deficits and also to ensure that control group children had vocabulary development in the normal range.

- In Studies 2 and 3 the raw scores obtained by the SLI children which correspond to age equivalent scores were used as a basis for identifying controls matched for vocabulary age
- It was used to describe the level of vocabulary development of the group with SLI at the time of Study 3.

Given that the BPVS had these important functions to perform in relation to the research, it is important to consider the extent to which the test is a reliable and valid measurement instrument.

8.6.2 Reliability of the BPVS

The reliability of a test is defined by Mc Cauley & Swisher (1984a) as "the consistency with which a test measures a given attribute or behavior" and furthermore they state that "if a perfectly reliable language test is used to measure language ability, an individual tested at different times during the same day will receive the same score each time"(p35).

A test can therefore be evaluated according to its test-retest reliability by assessing the same group of individuals on it twice within a short period of time. If the test scores from the first and second times show a high positive correlation, this indicates that the assessment has test-retest reliability. In the manual of the BPVS it is clearly stated however that there are " no direct measures of test-retest reliability for either the Short or the Long form of the test"(p 63) .

Instead in the manual it is stated that "the reliability of the BPVS has been assessed principally from the internal consistency of the tests" (p 61). To determine the internal consistency of the BPVS, the scores from odd and even items on the test were obtained separately and correlated. This provided measures of split half reliability for each year of age on the test. For the Short Form, a median reliability of 0.80 was obtained as an estimate of the accuracy of a score derived from one testing occasion.

It is clear from the above description that it should be assumed that a child's score on the BPVS is subject to some degree of measurement error. Indeed the test authors recognise that all assessments are imprecise instruments for they state that: "The score obtained from a psychometric instrument such as the BPVS provides only an estimate of a person's ability, in the attribute being measured. The exact ability is never known because some degree of measurement error is always present in the score" (p 20). Accordingly the test provides a range of scores or confidence intervals (using the individual's obtained score and the test reliability) within which a child's standard score, percentile rank and age level might fall 68 times in 100. According to Mc Cauley & Swisher (1984b) such confidence intervals provide much more information about the precision of the test's measurement than one can tell from the observed score alone and allows us to interpret an individual's test performance as a range of scores rather than a precise score.

This information about the reliability of the BPVS must be borne in mind when considering the research conducted in Studies 2 and 3. Firstly it will be recalled that children were identified as having normal or abnormal vocabulary development on the basis of their precise standard score. However taking measurement error into account we find that for each standard score, there is a range of scores within which the obtained score lies. Thus in identifying a child as having a vocabulary deficit one finds that unless that child has an obtained standard score of almost 2 standard deviations (or more) below the mean, the confidence interval extends into the normal range of scores. Similarly when trying to ensure that children in the control groups have vocabulary development within the normal range, we find that unless the child has a standard score of 91 or above, their score, on another occasion could extend into the abnormal range.

Despite this imprecision, clear differences in word learning performance between the SLI children and their age matched controls emerged. However it is possible that uncertainty about whether children were correctly categorised as having a vocabulary deficit or not on the basis of their BPVS scores may have obscured differences in performance between the SLI and the younger language age matched controls.

One way of allowing for measurement error in Study 2 would therefore have been to ensure that the impaired group had standard scores around two or more standard deviations below the mean and that the control groups had standard scores above 91. However this in turn may have resulted in a sample of children with SLI who had very severe difficulties and who were not necessarily representative of the population of SLI who have vocabulary deficits. It most likely would also have excluded children who had genuine vocabulary deficits and in doing so greatly added to the difficulty of finding subjects in a relatively short time scale.

Secondly children in the SLI and vocabulary age-matched control group were matched for the age equivalent of their raw score on the vocabulary test. There are two possible concerns with this. One is that the same problem of measurement error applies to the age equivalent scores. Consequently according to the test manual, a child's age equivalent score falls within (for the most part) a wide confidence interval of between 12 and 18 months.

Yet another problem is that even if it were possible to obtain precise age equivalent scores for a child's receptive vocabulary level, and even if two children obtained precisely the same level, it has been pointed out by Mc Cauley & Swisher (1984b) that we cannot conclude that the older SLI child and his/her younger language matched control obtain the same level of score for the same reasons. In other words the older child may be able to bring skills other than his receptive vocabulary to the test process which enable him to appear to have the same level of receptive vocabulary development as the younger child. Thus these two points illustrate the fact that the matching process in this research may have been rather less precise than first appears and this therefore means that the results from the comparison between the SLI children and their vocabulary age matched controls need to be interpreted with caution.

8.6.3 Validity of the BPVS

The validity of a test refers to the extent to which a test measures what it claims to measure.

In the manual for the BPVS the authors provide no evidence of concurrent validity but a reasonable argument for the content validity of the test. They state that the words used in it cover a breadth of vocabulary and that both words and pictures are appropriate for British children. Plante & Vance (1994) however advise that content validity "provides limited evidence for test validity in that it relies on expert judgement alone that test items reflect a content area" (p 15).

Plante & Vance (1994) suggest that there should be empirical evidence that a test is valid for the purpose for which it is used. In the case of the research conducted in the course of this thesis an important purpose was to identify children who had vocabulary deficits and those who did not, for the purposes of comparison on various measures. However empirical evidence that a test can achieve this comes from a discriminant analysis which according to these authors "provides information on the likelihood of a result happening by chance (statistical significance) and metrics that reflect the accuracy with which test scores discriminated between SLI and NL children" (p 21).

Such information is not available for the BPVS. Furthermore when Plante & Vance (1994) evaluated four American vocabulary tests with pre-school children, only one discriminated between children with impaired language development and those with normal language development.

8.6.4 Reliability and validity of the Graded Naming Test (GNT)

It will also be remembered that in Study 3 an unpublished assessment, The Graded Naming Test (Snowling & Stothard, 1998) was carried out. The results of this test were <u>not</u> used to identify children for inclusion in the main comparisons carried out in Study 3, or for matching. However the test was administered to measure the level of the children's expressive vocabulary and to identify children who despite falling into the normal range for receptive vocabulary had limitations in their expressive vocabulary.

This was the case in Study 3 when seven children with SLI achieved scores for receptive vocabulary which were within the normal range. Because it was considered possible that the results on tests of phonological learning and processing from these children might be bolstering the results of the whole group (and therefore not representative of the performance that might be expected of children with vocabulary deficits) it was decided to carry out a subgroup analysis using twelve SLI children who scored at least one standard deviation below the mean on either the BPVS, the Graded Naming Test or both.

The limitations of using the Graded Naming Test are however fully acknowledged, since as an unpublished assessment although it has obvious face validity, there is no published information about any other aspect of its validity.

With respect to its reliability, in recognition of the fact that all tests are subject to imprecise measurement, the authors report the standard error of measurement and the 95% confidence intervals for each age group. The recognised imprecision of the test must therefore leave open to question the possibility that the four children included in the subgroup analysis on the basis if their expressive vocabulary score alone may not have had expressive vocabulary scores outwith the normal range. Having said that two of the four had extremely low scores which were far below the mean score for children their age.

Despite these limitations the use of the GNT was justified by the fact that there is a dearth of British expressive vocabulary tests suitable for the wide age range of children included in Study 3.

In sections 8.6.2-8.6.4 some of the limitations in the reliability and validity of the language measures used in this thesis were described and discussed and the possible impact of these imperfections was acknowledged. However at the end of the day clinicians and researchers can only use those tools which are currently available as carefully as they can and, despite the shortcomings of some current measures of vocabulary development, significant and informative results have been obtained in this research and in other studies.

Unfortunately the limitations described are not unique to the tests used in this study. For example in a study of 30 speech and language tests Mc Cauley & Swisher (1984a) found that only 10% of the tests reviewed met four of ten important psychometric criteria selected for the review. Half of the tests met less than two. Furthermore the authors stated that the most frequently unmet criteria were those relating to empirical evidence of reliability and validity. It is therefore important that in the absence of more reliable and valid tests we are aware of the limitations of those currently available and take steps where possible to minimise the effect that the psychometric limitations of particular tests might have on both clinical and research practice.

8.6.5 The heterogeneity of children with SLI.

Although as stated in the previous section there was an attempt to ensure that children first selected for the study all had a receptive vocabulary deficit, there were differences both between and within individual children in the SLI group which may have had an impact on the results obtained.

Firstly children in the group differed from each other in the severity of their difficulties in comprehension and expression but also in whether or not they had pronunciation problems or difficulties with social interaction. Although there were no obvious subgroups of children at the time of Study 2, these variations in children's language profiles may have meant that the skills they brought to the word learning process differed. For example children with very poor comprehension may have found it more difficult to deduce meaning from context than children who had better receptive language. Hypothetically then, the precise nature of an individual child's word learning difficulty may depend on the type and severity of his other language difficulties. The fact that most of the children in the SLI group had rather global language difficulties at the time of

Study 2 may therefore be part of the reason why their word learning difficulties were characterised by problems acquiring phonological and semantic representations.

Not only were there variations between the children in their language profiles, the nature of SLI is such that characteristically there are variations within the profile of an individual child, with some areas of language weaker than others. This means that although the children with SLI were matched to controls for their level of vocabulary development, they may have differed from them in other aspects of their language development. In the same way that being older than the VAC group may have given the SLI children advantages over their younger peers with respect to attention and general experience of approaching tasks, better language skills in an area in which the groups were not matched may have obscured differences in word learning between the groups.

At the time of Study 3 there was less information available about the language profiles of the children with SLI. However the testing carried out at that time by the researcher (for the purposes of matching), showed that the children with SLI were no longer homogeneous with regard to whether they had a receptive vocabulary deficit and four of the children had no apparent difficulty with receptive or expressive vocabulary on testing. Because it was felt that the data from these particular children might be obscuring differences between the SLI and the VAC groups in particular, the data were analysed without these four children's scores. There was however little change in the pattern of results. This suggests that these particular variations in the group were not responsible for the pattern of results in which children with SLI differed significantly from age matched controls but were similar in many respects to their vocabulary age matched controls.

8.7 A tentative model of vocabulary acquisition

Although vocabulary acquisition in children with language impairment and those with normal language development is a complex area for research which involves many methodological constraints, it is nevertheless considered that the empirical work described in this thesis has contributed to the state of knowledge in this contentious field and allows the author to propose a tentative model for vocabulary acquisition. This model attempts to suggest some aspects of the way in which the correct semantic and phonological representations for previously unfamiliar words might be acquired.

Firstly the main components of the model will be described with their inclusion based on results derived from the work in this thesis together with some previous research. Secondly child based factors which might influence processing will be described.

8.7.1 Basic components of the model

A major premise of the model is that it should include semantic and phonological processing. The need for both is in keeping with the description proposed by Gathercole (1993) and reinforced by the results of Study 2. These results demonstrated that children with vocabulary deficits were poorer than age matched controls at learning the phonological form <u>and</u> the meaning of previously unfamiliar words thereby confirming the need for a model of vocabulary acquisition which includes both semantic and phonological processing.

At this point it is also important to state that the model of vocabulary acquisition proposed predominantly seeks to explain the way in which an individual processes the speech and language in which the unfamiliar word is embedded for the purposes of learning it. Consequently such a model of vocabulary acquisition will be more concerned with the processes brought to bear on the <u>incoming</u> information and will operate to derive and ultimately store semantic and phonological information.

Having specified the two main components of the model it is important to consider what sub-components each of these types of processing might encompass.

Firstly semantic processing skills should explain the means by which the individual solves the problem of deducing and retaining the meaning of novel words. The need to define the way in which children manage to achieve this is borne out by some of the results from Studies 1 and 2. It will be recalled that Study 1 demonstrated that two sets of words were equally easy to learn when presented in the same context to normally developing children. This in turn allowed the acquisition of the meaning of these words to be studied when each set was presented in a different context in Study 2. The fact that children's acquisition of meaning was poorer for words from the Story context where meaning had to be deduced by the child, than for words from the context where the meaning was explicitly defined, suggests that particular semantic processing skills are required to deduce the meaning of novel words from context. Furthermore it may be that semantic processing may involve different skills depending on the type of word for which the meaning is being deduced. The possible role that grammatical information might play in the deduction of word meaning has already been alluded to (see section 1.7.1.1.). In addition, as suggested by Daneman & Green (1986), working memory may enable an individual to retain information about a word derived from context in order to synthesise its meaning.

The difficulties experienced by the children with SLI on the assessments of phonological acquisition in Study 2, and the problems in acquiring a phonological representation in Study 3, suggest that a model of acquisition needs to include processes by which the speech sounds in unfamiliar words are accurately extracted and stored. The experimental work conducted in Study 3 was based on an model of speech perception described by (Bishop, 1997) but expanded to include the role of phonological memory in the phonological skills required for vocabulary acquisition. The reasoning was that recognising a familiar word and acquiring a new phonological form might involve similar speech sound processing skills. However it was argued that a model for the acquisition of a phonological representation needed to also include the contribution of phonological memory. This was important because when a new word is encountered there is no existing phonological form for it in the child's lexicon. Consequently the phonological form needs to be temporarily stored so that the word can be "laid down" in the individual's lexicon. Such temporary storage so that a more permanent representation can be set up is thought to be a function of phonological memory and research (Gathercole et al. 1992; Gathercole et al., 1999) has documented relationships between phonological memory and concurrent vocabulary and between phonological memory and the acquisition of the phonological form of new words (Gathercole and Baddeley, 1990; Gathercole et al. 1997).

Study 3 also explored whether there was a relationship between phonological processing and phonological learning. This was important since with the exception of the relationship between phonological memory and phonological learning this association had barely been investigated. Although in Study 3 the SLI group had poorer phonological processing skills than their peers (and on some assessments also poorer than younger children matched for level of vocabulary development) the lack of correlation between phonological processing and phonological learning and between phonological memory and phonological learning did not support the notion that the particular skills as tested in Study 3 were important for vocabulary acquisition. The possible reasons for these results were already discussed in Section 7.7.4 and will be briefly returned to in the next section when the effect of other influences on semantic and phonological processing for learning new words is discussed.

A model of vocabulary acquisition should also acknowledge that links between phonological and semantic representations need to be formed. The capacity to acquire such links successfully may be particularly important when children are confronted with the need to learn several new words at the same time. In Study 3 this was identified as a possible source of difficulty in children with SLI and points to the need to identify the cognitive skills upon which such linking may depend.

8.7.2 Influences and interactions

The discussion above focused on two main components of a model of acquisition. It was seen that previous research together with the empirical work carried out in this thesis supported the role of phonological <u>and</u> semantic processing in vocabulary acquisition.

It is likely however than any model of acquisition also needs to also take account of the influence of development on processing skills and the way in which some processing may or may not play a part according to the child's stage of development.

One strand of evidence for this comes from the fact that although children with SLI were poorer than both control groups in the discrimination of phoneme sequence change and on an assessment of phonological memory, neither of these skills were significantly associated with phonological learning. However such a relationship might have existed and been important had the children been younger when they were tested. This point has been already discussed in section 7.7.4

In the interests of making the model as comprehensive as possible it is also important to point out that a child's existing conceptual and linguistic knowledge will interact with the incoming information in the process of acquisition. Although it is beyond the scope of this discussion to explain how this might occur, two examples are provided. Firstly it is suggested that children might bring assumptions to vocabulary acquisition which serve to constrain the possible meanings of unfamiliar words (Markman & Hutchinson, 1984). A second example comes from the work of Gathercole et al. (1997) which suggests that children's ability to learn the phonological form of unfamiliar words depends on the use of their existing lexical knowledge as well as their phonological memory.

8.7.3 A summary of the model

To summarise, any model which seeks to explain the way in which children learn new vocabulary needs to include :

- Phonological processing skills (to extract and store the phonological representation of an unfamiliar word). These might include auditory discrimination, speech sound classification and phonological memory.

- Semantic processing skills (to infer and store the meaning of a previously unfamiliar word) These might include syntactic bootstrapping and working memory.

- Skills which enable the individual to link phonological and semantic information.

In addition the model should acknowledge that:

- Size of existing vocabulary may affect phonological processing for previously unfamiliar forms.

- Existing conceptual and semantic knowledge may interact with semantic processing.
- Semantic and phonological processing skills may interact in a variety of ways.
- The relative prominence of particular processing elements may be age determined.

8.8 Beyond Studies 2 and 3

8.8.1 Implications for Intervention

According to Dockrell and Messer (1999), "The first step in any intervention is to understand the nature of the task that is causing the child problems" (p.137). The results of Study 2 indicated that the nature of the word learning difficulty in a group of children with vocabulary deficits was in acquiring both semantic and phonological information for previously unfamiliar words. This in turn suggests the need to consider an emphasis on both these components of new words if they are being specifically taught. Furthermore those involved in providing such input need to monitor carefully the extent to which previously unfamiliar vocabulary has been learned. In other words, children's knowledge as a result of input should be evaluated in terms of whether they can perform successfully on tasks which require them to demonstrate reasonably complete phonological information and adequate semantic knowledge of new words.

Study 2 also suggested that children with vocabulary deficits benefit from additional exposure to previously unfamiliar words. Although repetition in itself is unlikely to be effective in closing the gap between the children with vocabulary deficits and their peers (as we saw when some Time 1 and Time 2 results were compared), repetition may have some value as part of an intervention approach.

The results of Study 3 did not as hoped provide evidence of a relationship between phonological learning and measures of phonological processing and memory. As a result no clear implications for intervention emerged from Study 3.

8.8.1.1 Future Research

Word learning and children with word finding deficits

Studies 2 and 3 have built on previous research and have suggested experimental paradigms for studying word learning which might be extended to the subgroup of children with vocabulary deficits who have word-finding difficulties. There are two reasons to consider it possible that children with WFDs might also have word learning problems.

Firstly it will be recalled that one of the main criteria for identifying the experimental group in Study 2 was their poor receptive vocabulary. However information from speech and language therapists around the time of Study 2 suggested that the vast majority of the children also had expressive vocabulary deficits. Although there was no specific information sought about whether any of the group had word-finding difficulties, it is possible that some did. Looked at another way, the fact that children with WFDs can also have receptive vocabulary deficits (Faust et al., 1997; Dockrell, 1998), suggests areas of overlap between groups of children who have lexical deficits. This in turn might make word learning difficulties a reasonable explanation for groups other than the group investigated in Study 2.

Previous support for the notion that word-learning difficulties might also explain WFD in children comes from accounts which have stressed deficient phonological and/or semantic storage as a problem in these children (Constable et al., 1997; Faust et al. 1997; Kail & Leonard 1986; McGregor & Windsor 1996; McGregor, 1997).

Thus in relation to impoverished phonological representations, Constable et al. (1997) provided evidence from a single case study that a seven year old boy had difficulty rejecting incorrect pronunciations for items that he had difficulty naming. Faust et al. (1997) suggested, following a naming task in which children with vocabulary deficits which included WFD were encouraged to provide semantic and phonological information about words that they were unable to name, that "the phonological specifications of the target words were not perhaps sufficiently established for retrieval" (p1032). Other authors (Kail and Leonard, 1986; McGregor and Waxman, 1998) have suggested that children with WFD have less elaborate semantic representations stored for words. Although these accounts emphasise limitations in the information stored about new vocabulary, the assessment of word learning by children with WFD from naturalistic contexts such as those described in Study 2 might provide further information about the nature of their difficulties.

Yet another possibility is that the problems with lexical linking which were apparent in the children with more general lexical deficits in Study 3 may also provide part of the explanation for word-finding difficulties. (It may be recalled that lexical linking was a task in which familiar words were presented as paired associations. In the test phase the child had to provide the second word of the pair when told the first. In order to be successful children must, among other things have associated the two pieces of lexical information in memory).

It has been suggested in models of word production such as Ellis and Young's (1998) model that when shown a picture (as is common in confrontation naming tasks to test children's word-finding ability), first the semantic information is accessed followed by the phonological representation. It therefore follows that if semantic and phonological information is not sufficiently associated, children may be able to provide the meaning of the word while the phonological form escapes them. Certainly some work by Lewis and Speake (1998) suggested that this was an area requiring intervention in a boy with word - finding difficulties.

In conclusion Study 2 did not specifically investigate word learning in children with word-finding difficulties and this is an area which might merit further study.

Further studies addressing the sources of word learning deficits

Although Study 3 focused on phonological processing and memory and the acquisition of the phonological representation, further research might usefully explore the type of deficits which may underlie the children's ability to acquire the meaning of new words.

One approach might be to investigate the skills and cognitive processes which might contribute to children's ability to deduce meaning from context. According to Daneman and Green (1986), this ability makes a significant contribution to the extent of an individual's vocabulary and Sternberg (1987) claims that most vocabulary is learned from context. In such an investigation, processes such as those described by Sternberg (1987) might be explored. These include: selective encoding "the ability to separate relevant from irrelevant information in formulating a definition, selective combination "combining relevant cues into a workable definition" and selective comparison "a process by which new information about a word is related to old information stored in memory" (p.91). It may also be important to consider children's working memory capacity since Daneman and Green view this an important underlying skill for deriving meaning from context.

Finally the question of whether phonological processing and memory deficits are implicated in difficulty acquiring the phonological form of new words should not be abandoned on the basis of the results from Study 3. It will be remembered that in Study 2 the group with vocabulary deficits had marked difficulty on an assessment which differentially emphasised phonological learning and that they were also poorer at nonname learning in Study 3. This suggests that the underlying reasons for difficulties apparent on these tasks merit further study, perhaps using more sensitive measures of, in particular, phonological processing. In addition the assessment of phonological processing and memory in a younger group of children with vocabulary deficits might identify a relationship between phonological learning and phonological memory and processing which might be important at a particular stage in development.

8.8.2 The last word on vocabulary deficits

Crystal (1987) suggested that "Vocabulary is the last large mountain to be scaled within the domain of language structure"(p 56). It is hoped that this thesis has taken us a few steps up the mountain.

Appendix 1
Characteristics of the experimental words used in Studies 1 and 2.

Word	Context	*Mean Age of Acquisition Rating	*Mean Familiarity Rating	Adult speech to 5 year olds Hall, et al (1984) Frequency per million words	Syllables	Definition
Polka	Story	5.71	2.81	White middle class 2 White working class 0	2	fast dance
Molasses	Story	6.06	3.09	White middle class 0 White working class 0	3	brown food
Aster	Story	6.31	2.05	White middle class 0 White working class 0	2	blue flower
Phial	Story	6.53	2.73	White middle class 0 White working class 0	1	small bottle
Kale	Explicit Teaching Replaced *jade* in Studies 1 and 2	5.75	2.56	White middle class 0 White working class 0	1	green vegetable
Gauntlet	Explicit Teaching	5.11	3.14	White middle class 0 White working class 0	2	long glove
Mica	Explicit Teaching Replaced *brigand* in Studies 1 and 2	6.26	2.53	White middle class 0 White working class 0	2	shiny stone
Albatross	Explicit Teaching	5.28	3.09	White middle class 0 White working class 0	3	big bird
Brigand	Explicit Teaching Pilot study only	5.89	2.70	White middle class 0 White working class 0	2	bad man
Jade	Explicit Teaching Pilot Study only	5.72	3.59	White middle class 0 White working class 0	1	green stone

*** Gilhooly and Logie (1980)**

Appendix 2

Learning and other demands of the assessment tasks used in Study 2.

	Type of information required for scoring	**Phonological representation**	**Semantic representation**	**Additional factors to be considered**
Naming	Phonological Representation and output	Full	Partial may suffice	Difficulties with retrieval or speech output may interfere
Word Recognition *	Phonological Representation.	Partial	(May be helpful but may not be necessary)	Metalinguistic demands of the task Chance element
Word Description (added during the pilot study)	Semantic Representation	Partial may suffice	Full **	Difficulty with the notion of definition
Meaning Recognition	Semantic Representation	Partial may suffice	Full **	Chance element
Picture Comprehension (altered following the pilot study)	Semantic Representation	Partial may suffice	Partial may suffice	Chance element

*Picture may activate a semantic representation

** A full semantic representation in this context is defined as one in which both of the "taught" aspects of meaning are correct

Appendix 3
Pre-test (Study 1) : Explicit Teaching context words

Child Ref No__________________ **Date**_______________

I'm going to say some words to you. Some of them will be words you've heard before like bus, dog, house. Some of the words you won't have heard before like bizlebop, or anagram.
I want you to say "yes" to the ones you've heard and "no" to the ones you haven't heard before.

Practise Items

Word	**Status**	**Response**	**Meaning**
Plirt	Non	Yes **Probe meaning if yes** No	
Potato	**AOA (E)**	Yes No **What is it?**	
Canal	AOA (L)	Yes No	
Larkspur	New	Yes No	

Word	**Status**	**Response**	**Meaning**
1. Albatross	**New**	Yes No **Can you guess what it is?**	
2. Glistow	Non	Yes **Probe meaning if yes** No	
3. Holiday	*AOA (E)	Yes No **What is it?**	
4. Gauntlet	**New**	Yes No **Can you guess what it is?**	
5. Barrel	**AOA (L)	Yes No	
6. Kale	**New**	Yes No **Can you guess what it is?**	
7. Hero	AOA (L)	Yes No	
8. Teacher	AOA (E)	Yes No **What is it?**	
9. Rain	AOA (E)	Yes No **What is it?**	
10. Tef	Non	Yes **Probe meaning if yes** No	
11. Pocket	AOA (E)	Yes No **What is it?**	
12. Mica	**New**	Yes No **Can you guess what it is?**	
13. Leek	AOA (L)	Yes No	
14. Frescovent	Non	Yes **Probe meaning if yes** No	
15. Fisherman	AOA (L)	Yes No	
16. Bannow	Non	Yes **Probe meaning if yes** No	

*AOA (E) = a word with an early age of acquisition **AOA (L)= a word with a late age of acquisition

Appendix 3
Pre-test (Study 1) Story context words

Child Ref no___________________ Date________________

I'm going to say some words to you. Some of them will be words you've heard before like bus, nose, house. Some of the words you won't have heard before like bizlebop, or anagram.
I want you to say "yes" to the ones you've heard and "no" to the ones you haven't heard before.

Practise Items

Word	Status	Response	Meaning
Ballop	Non	Yes **Probe meaning if yes** No	
Dog	AOA (E)	Yes No **What is it?**	
Hose	AOA (L)	Yes No	
Rhapsody	New	Yes No	

Word	Status	Response	Meaning
1. Molasses	**New**	Yes No **Can you guess what it is?**	
2. Cake	*AOA (E)	Yes No **What is it?**	
3. Shoom	Non	Yes. **Probe meaning if yes** No	
4. Cellar	**AOA (L)	Yes No	
5. Rabbit	AOA (E)	Yes No **What is it?**	
6. Apricot	AOA (L)	Yes No	
7. Polka	**New**	Yes No **Can you guess what it is?**	
8. Lady	AOA (E)	Yes No **What is it?**	
9. Tafflest	Non	Yes **Probe meaning if yes** No	
10. Skiticult	Non	Yes **Probe meaning if yes** No	
11. Phial	**New**	Yes No **Can you guess what it is?**	
12. Animal	AOA (E)	Yes No **What is it?**	
13. Diller	Non	Yes **Probe meaning if yes** No	
14. Aster	**New**	Yes No **Can you guess what it is?**	
15. Costume	AOA (L)	Yes No	
16. Straw	AOA (L)	Yes No	

*AOA (E) = a word with an early age of acquisition **AOA (L)= a word with a late age of acquisition

Appendix 4
Naming Test: Story context words

Child Ref No ______________ Date ______________

N.B. If the child uses generic term for any item- prompt "Do you know its name?"

Question	Child's response (Transcription)	Score
What do you call this? (Aster)		
What do you call this? (Polka)		
What do you call this? (Molasses)		
What do you call this? (Phial)		

Naming Test: Explicit Teaching context words

Child Ref No ______________ Date ______________

N.B. If the child uses generic term for any item - prompt "Do you know its name?"

Question	Child's response (Transcription)	Score
What do you call this? (Mica)		
What do you call this? (Gauntlet).		
What do you call this? (Albatross)		
What do you call this? (Kale)		

Scoring

2 - correct form or minor phonetic variations. 1- 50% or more of the sounds from target word present and in the correct order in the child's form. 0- Less than 50% of the sounds from the target word present and in correct sequence.

Appendix 5
Word Recognition Test for Study 1 : Story context words

Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but **one time** I'll say the name just right. You've to put a sticker in one of the boxes for the time I said it just right. Lets practise first.

Is it **[t͡ʃɔpl̩t]**	**t͡ʃɪpl̩t]**	**[t͡ʃɔkl̩t]**	**[t͡ʃɪkl̩t]**
Is it **[bɪtanʌ]**	**[bɪnanʌ]**	**[bɪtonʌ]**	**[bɪnonʌ]**
Is it **[tuzʌl]**	**[tebʌl]**	**[tezʌl]**	**[tubʌl]**
Is it **[dɔp]**	**[deg]**	**[dep]**	**[dɔg]**

Now we'll do the same with these ones

Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[fal]** Phal **1**	**[fael]** Phial **2**	**[fam]** Pham **0**	**[faem]** Phiam **1**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[Molakɪz]** Mollakes **1**	**[molasɪz]** Molasses **2**	**[molosɪz]** Molosses **1**	**[molokɪz]** Molokes **0**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[eptʌr]** Aypter **0**	**[estʌr]** Ayster **1**	**[aptʌr]** Apter **1**	**[astʌr]** Aster **2**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[poŋkʌ]** Pongka **1**	**[polkʌ]** Polka **2**	**[piŋkʌ]** **Pee**ngka **0**	**[pilkʌ]** **Pee**lka **1**

Appendix 5
Word Recognition Test for Study 1: Explicit Teaching context words

Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but **one time** I'll say the name just right. You've to put a sticker in one of the boxes for the time I said it just right. Lets practise first.

Is it **[bɔv]**	**[bel]**	**[bɔl]**	**[bev]**
Is it **bɪlkɪt**	**[bɔskɪt]**	**[bɪskɪt]**	**[bɔlkɪt]**
Is it **[tɛpɪ]**	**[tɛdɪ]**	**[todɪ]**	**[topɪ]**
Is it **[ʌmbrɛlʌ]**	**[ʌmkrolʌ]**	**[ʌmkrɛlʌ]**	**[ʌmbrolʌ]**

Now we'll do the same with these ones

Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[maedʌ]** Mida **1**	**[maekʌ]** Mica **2**	**[mokʌ]** Moca **1**	**[modʌ]** Moda 0
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[olbʌtrɔs]** Olbatross **1**	**[ombʌtrɔs]** Ombatross **0**	**[albʌtrɔs]** Albatross **2**	**[ambʌtrɔs]** Ambatross **1**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[gɔstlɪt]** Gawstlet **1**	**[gestlɪt]** Gaystlit **0**	**[gentlɪt]** Gayntlet **1**	**[gɔntlɪt]** Gauntlet **2**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[kel]** Kale **2**	**[kag]** Kag **0**	**[keg]** Kayg **1**	**[kal]** Kal **1**

Appendix 6
Meaning Recognition Test : Story context words

Child Ref no ____________________ **Date**________________

Now I'm going to ask you some questions and I want you to tell me if the answer is "yes" or "no". Let's practise first.

Is my watch on the floor?
Is your hair green ?
Is your name X?
Is an elephant big?
OK now we can start.

Question	Response
1. Is an aster a tree?	Yes **no**
2. Is molasses yellow?	Yes **no**
3. Is an aster orange ?	Yes **no**
4. Is a polka fast ?	**Yes** no
5. Is a phial a box ?	Yes **no**
6. Is molasses brown ?	**Yes** no
7. Is an aster a flower ?	**Yes** no
8. Is a polka slow ?	Yes **no**
9. Is a phial a bottle ?	**Yes** no
10. Is molasses a drink ?	Yes **no**
11. Is a phial small ?	**Yes** no
12. Is a polka a game ?	Yes **no**
13. Is an aster blue ?	**Yes** no
14. Is molasses a food ?	**Yes** no
15. Is a phial big ?	Yes **no**
16. Is a polka a dance ?	**Yes** no

Appendix 6
Meaning Recognition Test : Explicit Teaching context words

Child ________________ **Date**________________

Now I'm going to ask you some questions and I want you to tell me if the answer is "yes" or "no". Let's practise first.
Is your mum a boy?
Is your mum under the table?
Is chocolate nice?
Is an mouse big?
OK lets do some more now

Question	Response	
1. Is a gauntlet a glove ?	**Yes**	no
2. Is mica shiny?	**Yes**	no
3. Is an albatross a bird ?	Yes	no
4. Is kale red?	Yes	no
5. Is mica a stone?	**Yes**	no
6. Is a gauntlet a sock?	Yes	**no**
7. Is mica dull?	Yes	**no**
8. Is kale an animal ?	Yes	**no**
9. Is an albatross big ?	**Yes**	no
10. Is kale green ?	**Yes**	no
11. Is an albatross a fish ?	Yes	**no**
12. Is a gauntlet long ?	**Yes**	no
13. Is kale a vegetable?	**Yes**	no
14. Is mica a tree?	Yes	**no**
15. Is a gauntlet short ?	Yes	**no**
16. Is an albatross small	Yes	**no**

Appendix 7
Picture Comprehension Test Form (Pilot Study only)

Child ref no__________ **Date** ___________

Story Items

1. Yellow food (custard) S	2. Fast dance (Polka) **M**	3.Big box **N**
4. Brown drink (coke) **S**	5. Small box **N**	6. Brown food (molasses) **T**

1. Yellow flower **S**	2. Blue Flower (Aster)**T**	3. Cold drink (orange) **N**
4. Small bottle (phial) **M**	5. Blue tree **S**	6.Hot drink (tea) **N**

1. Big bottle **S**	2. Small bottle (Phial) **T**	3. Green food **N**
4. Small box **S**	5. Blue flower (Aster) **M**	6. Yellow food **N**

1. Fast dance (Polka) **T**	2. Small tree **N**	3. Slow dance **S**
4. Big tree **N**	5. Fast game **S**	6. Brown food (Molasses)**M**

Explicit Teaching Items

1.Long glove (Gauntlet)**M**	2. Small bird **S**	3.Happy lady **N**
4. Big Bird (Albatross) **T**	5. Sad lady **N**	6. Big Fish. **S**
1 Big fish **N**	2. Good man (policeman) **S**	3. Green stone (Jade) **M**
4. Bad lady (witch) **S**	5.Small fish **N**	6. Bad man (Brigand) **T**

1. Long sock **S**	2. Red stone **N**	3. Short glove (mitt) **S**
4. Long glove (Gauntlet)**T**	5. Bad man (Brigand) **M**	6. Blue stone **N**

1.Big bird (Albatross) **M**	2. Red stone **S**	3. Green stone (Jade) **T**
4. Fat man **N**	5. Good man **N**	6. Green plant **S**

S= semantic distracter, N= neutral distracter, M= mapping distracter. T= target

Appendix 8
Revised Picture Comprehension Test: Story context words

Child ref no _______ Date____________

Find me the…

1.

Polka	Phial
Aster	Molasses

2.

Aster	Molasses
Phial	Polka

3.

Phial	Aster
Polka	**Molasses**

4.

Phial	**Aster**
Molasses	Polka

Now I am going to do them again in a different order.

5.

Molasses	Phial
Aster	Polka

6.

Aster	Molasses
Polka	**Phial**

7.

Polka	Phial
Molasses	Aster

8.

Phial	Molasses
Polka	**Aster**

Appendix 8
Picture Comprehension Test : Explicit Teaching context words

Child _______ Date______________

Find me the.....

1.

Albatross	Gauntlet
Kale	Mica

2.

Kale	Gauntlet
Albatross	Mica

3.

Albatross	Mica
Gauntlet	Kale

4.

Gauntlet	**Mica**
Albatross	Kale

Now I am going to do them again in a different order.

5.

Gauntlet	**Albatross**
Kale	Mica

6.

Mica	Albatross
Gauntlet	Kale

7.

Gauntlet	Mica
Kale	Albatross

8.

Albatross	**Mica**
Gauntlet	Kale

Appendix 9
Word Description Test : Story context words

Child ref no______________________ Date___________________

Words to be presented randomly

Word	**Description**	**Score**
Tell me all about the phial.		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say It's a __________......		
Tell me all about the polka		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		
Tell me all about the aster		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		
Tell me all about the molasses		
What is it?		
If they give category-"What kind of _________ is it?		
If they give attribute . Say "It's a ______________......"		

Appendix 9
Word Description Test : Explicit Teaching context words

Child ref no______________________ Date__________________

Words to be presented randomly

Word	**Description**	**Score**
Tell me all about the kale		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		
Tell me all about the mica		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		
Tell me all about the gauntlet		
What is it?		
If they give category-"What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		
Tell me all about the albatross		
What is it?		
If they give category- "What kind of _________ is it?"		
If they give attribute . Say "It's a __________......"		

Appendix 10

Revised Pretest for both word sets in Study 2 (Test form only).

I'm going to say some words to you and I want you to point to the right picture. Some of the words I say you won't have heard before. If you don't think you've heard the word before, point to the empty box. Lets practise first . (Three items were presented for practise).

Remember to point to the empty box if you don't think you've heard the word before.

1.

a Trowel		d Metronome
b Bandstand	**Empty Box**	**e Phial**
c Sextant		f Igloo

2.

a Cutlery		d Seat
b **Table**	**Empty Box**	e Pencil
c Robin		f Race

3.

a Kale		d Auroscope
b Barn	**Empty Box**	e Hoe
c Sundial		f Seaweed

4.

a Experiment		d Wheat
b Beaver	**Empty Box**	e Swan
c Unusual Tool		**f Mica**

5.

a Flats		d **Face**
b Dog	**Empty Box**	e Bear
c Book		f Leaf

6.

a Ivy		d Whisk
b Cliffs	**Empty Box**	**e Gauntlet**
c Bunsen Burner		f Thermostat

7.

a **Bed**		d Church
b Iron	**Empty Box**	e Skipping Rope
c Wheelbarrow		f Ring

8.

a Beetroot		d Experiment
b Pincer type object	**Empty Box**	e Plant
c Molasses		f Factory

9.

a Albatross		d Ear Syringe
b Dressing table	**Empty Box**	e Grasshopper
c Scorpion		f Dam

10.

a Colander		d Polka dots
b Polka	**Empty Box**	e Pumpkin
c Seaside		f Unusual Shape

11.

a Aster		d Funnel experiment
b Terraces	**Empty Box**	e Bolt
c Unusual shape		f Leek

12.

a Ducks		d Shell
b House	**Empty Box**	e **Tree**
c Climbing frames		f Glasses

Appendix 11

Revised Word Recognition Test for Study 2: Story context words

Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but **one time** I'll say the name just right. You've to put a sticker in one of the boxes for the time I said it just right. Lets practise first.

Is it? [t͡ʃeklt]	[t͡ʃɪklt]	**[t͡ʃɔklt]**	[t͡ʃiklt]
Is it? **[bɪnanʌ]**	[bɪnasʌ]	[bɪnagʌ]	[bɪnatʌ]
Is it? [tubʌl]	**[tebʌl]**	[tɔbʌl]	[tʌbʌl]
Is it? [dɔz]	[dɔr]	[dɔp]	**[dɔg]**

Now we'll do the same with these ones

Find the time I said the name of the picture just right. Is it?			
Get Sticker! [mʌlosɪz]	[mʌlesɪz]	**[mʌlasɪz]**	[mʌlisɪz]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [estʌr]	**[astʌr]**	[ustʌr]	[ostʌr]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [fʌul]	**[fael]**	[fʌl]	[fel]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [pɛlkʌ]	[pilkʌ]	**[polkʌ]**	[palkʌ]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [altʌr]	**[astʌr]**	[aptʌr]	[antʌr]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[mʌlasɪz]**	[mʌladɪz]	[mʌlanɪz]	[mʌlakɪz]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [faes]	**[fael]**	[faeb]	[faem]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [poskʌ]	**[polkʌ]**	[popkʌ]	[poŋkʌ]

Appendix 11
Revised Word Recognition Test for Study 2: Explicit Teaching context words

Now I am going to say the names of some pictures. Sometimes I'll say the names in a funny way but **one time** I'll say the name just right. You've to put a sticker in one of the boxes for the time I said it just right. Lets practise first.

Is it [bel]	[bil]	**[bɔl]**	[bʌl]
Is it [bɪlkɪt]	[bɪpkɪt]	[bɪrkɪt]	**[bɪskɪt]**
Is it [todɪ]	[tʌdɪ]	[tudɪ]	**[tɛdɪ]**
Is it [ʌmbrɛgʌ]	**[ʌmbrɛlʌ]**	[ʌmbrɛtʌ]	[ʌmbrɛsʌ]

Now we'll do the same with these ones

Find the time I said the name of the picture just right. Is it?			
Get Sticker! [mokʌ]	**[maekʌ]**	[mɔkʌ]	[mukʌ]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [olbʌtrɔs]	[elbʌtrɔs]	**[albʌtrɔs]**	[ulbʌtrɔs]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [gantlɪt]	[gintlɪt]	[gentlɪt]	**[gɔntlɪt]**
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[kel]**	[kʌul]	[kʌl]	[kal]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [ambʌtrɔs]	[agbʌtrɔs]	**[albʌtrɔs]**	[aʃbʌtrɔs]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [gɔstlɪt]	[gɔftlɪt]	**[gɔntlɪt]**	**POST ALVEOLAR r** [gɔrtlɪt]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! [keb]	**[kel]**	[keð]	[keg]
Find the time I said the name of the picture just right. Is it?			
Get Sticker! **[maekʌ]**	[maetʃʌ]	[maedʌ]	[maesʌ]

Appendix 11
Word Recognition Test : Child's Response Grid

Child Ref no __ Date_____

Appendix 12

Script & Pictures for Story: "Get Better Mum"

One Saturday morning mum woke up and she didn't feel very well. She had lots of spots on her face and she felt very tired.

"Stay in bed till you feel better," said dad, "I'll look after everything in the house."

"Poor mum "said Louise "I wish we could make her better"

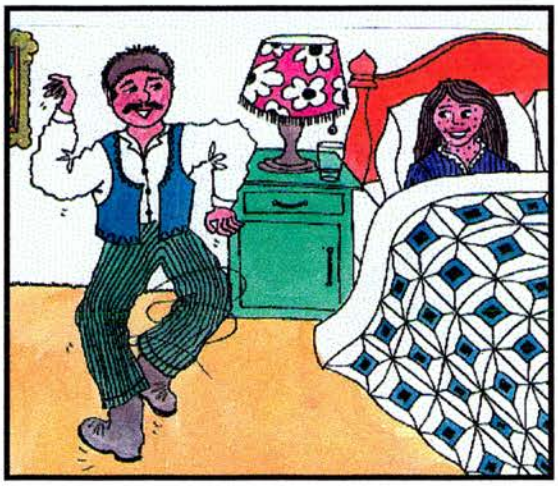
"I've got a good idea" said Jamie. "We could go and get her an **aster."**

Jamie and Louise went out into the garden and picked a lovely **aster** for mum.

They took the **aster** upstairs and gave it to mum.

"Oh thank you", said mum when she saw the **aster** and she stuck her head in it to see if it smelled nice. Suddenly mum started to sneeze "Oh dear" she said "I think maybe this **aster** is making me sneeze. Can you take the **aster** away and put it in your room?"

"Well that idea wasn't much good", said Jamie. "We'll need to think of something else to make mum feel better". "I know", said Louise. "We could ask uncle Terry to come round and do the **polka** for mum."



Uncle Terry came round at 2 o'clock. "Get the music on" he cried "I'll do a **polka**." The music started and mum watched Uncle Terry do the **polka**. She thought it looked fun. "Come on," said Uncle Terry. "Get out of bed, it's your turn for the **polka.**"

Appendix 12

Before she knew it, uncle Terry had dragged mum out of bed to do the **polka** with him. Faster and faster they went. "Hey slow down, slow down" said mum, "I can't keep up".

Just at that moment Uncle Terry stood on mum's toe with his big black boot. "Ouch, ow, oh no! That's enough of the **polka** " said mum. "You've hurt my toe. I'll need to get back into bed."

"Well that wasn't a terribly good idea" said Louise . "So far we haven't made mum feel better at all. All we've managed to do is make her sneeze and now she's got a sore toe as well."

"Never mind" said Jamie . "Let's give her some **molasses** I bet she would like that."

Jamie and Louise went into the kitchen and looked in the cupboard. They found some crispies and a new tin of **molasses**. Jamie opened the tin and spooned lots of **molasses** on top of a plate of crispies. "That's enough **molasses** " said Louise.

They put the plate on a tray and carried it upstairs to mum. Mum took the tray and saw the crispies and **molasses**. She didn't fancy it very much but she ate every spoonful to please the children.

Suddenly she felt a bit sick. "Oh dear" she said "I think I've had just too many crispies and **molasses** ."

"Oh no" said Jamie. "All our ideas just make things worse. Poor mum doesn't feel better at all." "Never mind" said dad. "Let's call the doctor, I'm sure he'll make mum better."

At 5 o'clock the doctor came. "How are you?" he asked mum. "Terrible I'm afraid" said poor mum. "Never mind" said the doctor "We'll soon have you feeling much better. Just let me get a **phial** out of my bag."

Dr. Mackintosh opened his bag and took out a **phial**. There was pink medicine in the **phial.** "Get me a spoon please and I'll give you some of this right away."

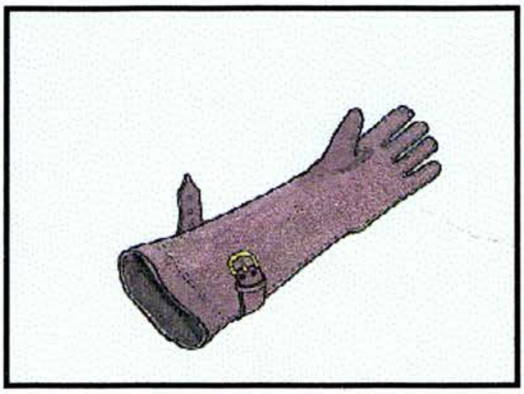
The doctor carefully poured some medicine out of the **phial** onto a teaspoon and gave it to mum. "Now" he said, "put this **phial** somewhere safe and at night-time take another spoonful from it. In the morning you'll be much better."

Mum put the **phial** carefully on her bedside table and said bye-bye and thank you to the doctor.

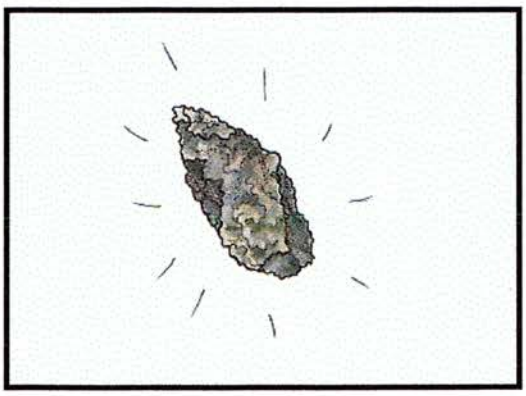
In the morning, just as the doctor said, mum felt much better. She got up, got dressed and went downstairs. "Hooray" shouted dad and the children. "Great to have you better!"

Appendix 13

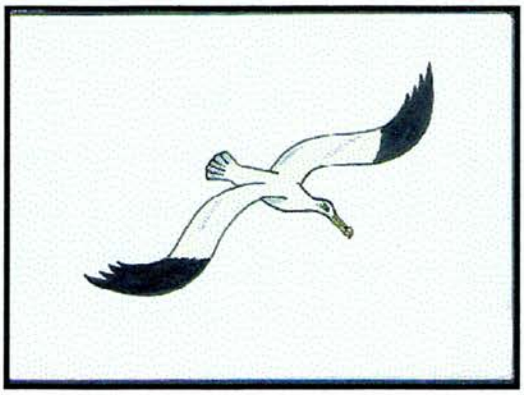
Pictures & Text for Explicit Teaching Context



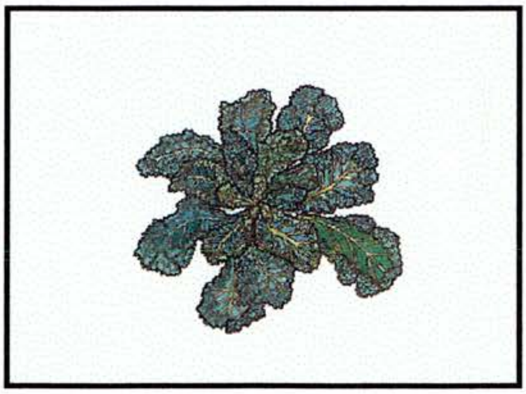
"First we'll look at the **gauntlet.** OK this is a **gauntlet.** A **gauntlet** is a kind of glove. A **gauntlet** is a long glove. Can you see how long this **gauntlet** is? Right let's leave the **gauntlet** and look at another one."



"Now we'll look at the **mica.** OK this **mica**. **Mica** is a kind of stone. **Mica** is a shiny stone. Can you see how shiny this **mica** is? Right we'll put the **mica** away and do another one."



“Next we’ve got the **albatross**. OK this is an **albatross** . An **albatross** is a kind of bird. An **albatross** is a big bird. Can you see how big this **albatross** is ? Right we’ve talked about the **albatross**.”



“Lets look at the **kale** (now). OK this is **kale**. **Kale** is a kind of vegetable. **Kale** is a green vegetable. Can you see how green this **kale** is? Right we’ve looked at the **kale**, let’s do some thing else.”

Appendix 14
Information for Parents.

Vocabulary deficits in children with Specific Language Impairment : An investigation with a view to intervention.

I am an experienced speech and language therapist working at the Royal Hospital for Sick Children and also studying for a Ph.D. at the University of Edinburgh.
The aim of my study is to find out why children with language problems sometimes have difficulty learning new words as easily as children who have no language difficulty. I also aim to find out if I can improve word learning in children who have difficulties in this area. It is hoped that this information will be useful in planning therapy which is more closely tailored to the needs of individual children.

If you agree to your child taking part in the study, I will arrange to see your child to carry out some speech and language assessment and also a short assessment of skills which do not involve language. For some children this may be all I will require. However most children will then go on to be given opportunities to learn some new words. These words will be presented to your child in 2 ways. The first will be in a story specially designed to be appealing and humorous. The second will be a situation with picture cards in a game which I will use to tell your child about some more new words. Following the learning opportunities I will assess what your child has learned and remembered about the new words. Including the initial assessment, I will need to see your child for 6 short sessions. Some of these will need to be on consecutive days. I would expect that most of these visits will take place at school. However if more convenient, I may visit your child at home or at the clinic attended for speech therapy.

At a later stage, probably 6-12 months after this initial phase of the study, I will want to see some children again. If your child is one of them, I will need to see him/her for a further 1-2 sessions of short tests looking at some of the skills which may be important for effective word learning. You will given information at that time about this second phase and will be asked if you agree to your child participating.

Finally if I have sufficient time, I may wish to try out specific therapy with your child based on the findings of the first 2 parts of the study. If this part of my research goes ahead and I wish to include your child, I will provide you with further written information about what it would involve at that time and ask for consent to include your child in this part of the study.

At all times the information I have about your child will be confidential and he/she will not be identified by name in any of the information I collect.

I do hope that after reading this information and talking to your own speech and language therapist, that you feel able give your consent. **Participation is entirely voluntary however and should you wish to change your mind for any reason, you may withdraw at any time. This will not affect any speech/language therapy provision your child is currently receiving**. If you would like to speak to me before making up your mind, please do get in touch.

Marysia Nash.
(address and telephone number included)

Appendix 14
Parental Consent Form

Vocabulary deficits in children with Specific Language Impairment : An investigation with a view to intervention.

- I have read this consent form and the subject information sheet and I have had the opportunity to ask questions about the study.

- I understand that my General Practitioner will be informed that my child is participating in this research.

I understand that I am under no obligation to allow my child to participate in this study and that I may withdraw my child from the project at any time without being required to provide any explanation. I understand that this will not affect any treatment my child currently receives.

- I understand that tape-recorded or written records will only be used for research purposes, and that my child will **not** be identified by name on these at any time.

- I understand that this is non therapeutic research from which the subject cannot expect to derive direct benefit.

- I agree to my child...(name of child) participating in the above research project.

Name of Parent / Guardian..

Signed...Date..........................

4 copies to be made.

Top copy to be retained by researcher
Copies to be provided for: Parent/ Guardian
Child's GP
Child's Speech and Language Therapist.

Appendix 15

Summary Profiles of Specific Language Impairment: Study 2

This table gives a visual impression of the range of difficulties experienced by children in the SLI group. Where a box is shaded, this indicates an area of difficulty. It can be seen that most children had widespread language difficulties including both comprehension and expression. Quite a number of children also had problems with the social use of language

Child	Receptive vocabulary	Comprehension	Expressive language (grammar)	Expressive vocabulary	Phonology	Social communication
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						

Appendix 16
Information for Parents. (Control groups)

Vocabulary deficits in children with Specific Language Impairment : An investigation with a view to intervention.

I am an experienced speech and language therapist working at the Royal Hospital for Sick Children and also studying for a Ph.D. at the University of Edinburgh.
The aim of my study is to find out why children with language problems sometimes have difficulty learning new words as easily as children who have no language difficulty. I also aim to find out if I can improve word learning in children who have difficulties in this area. It is hoped that this information will be useful in planning therapy for children with vocabulary problems that is more closely tailored to their needs.

Such a study requires me not only to look at word learning in children with language impairment, but also to include children whose language is developing normally.

If you agree to your child taking part in the study, I will arrange to see your child to carry out some speech and language assessment and also a short assessment of skills which do not involve language. For some children this may be all I will require. However most children will then go on to be given opportunities to learn some new words. These words will be presented to your child in 2 ways. The first will be in a story specially designed to be appealing and humorous. The second will be a situation with picture cards in a game which I will use to tell your child about some more new words. Following the learning opportunities I will assess what your child has learned and remembered about the new words. Including the initial assessment, I will need to see your child for 6 short sessions. Some of these will need to be on consecutive days. I would expect that most of these visits will take place at school.

At a later stage, probably 6-12 months after this initial phase of the study, I will want to see some children again. If your child is one of them, I will need to see him/her for a further 1-2 sessions of short tests looking at some of the skills which may be important for effective word learning. You will given information at that time about this second phase and will be asked if you agree to your child participating.

At all times the information I have about your child will be confidential and he/she will not be identified by name in any of the information I collect.

I do hope that after reading this information, that you feel able to give your consent. **Participation is entirely voluntary however and should you change your mind for any reason, you may withdraw your child from the study at any time.** If you would like to speak to me before making up your mind, please do get in touch.

**** This version of the information sheet will be used for the parents of children with normal language development***

Marysia Nash.
(address and telephone number included)

Appendix 16

Parental Consent Form (Control groups)

Vocabulary deficits in children with Specific Language Impairment : An investigation with a view to intervention.

- I have read this consent form and the subject information sheet and I have had the opportunity to ask questions about the study.

- I understand that I am under no obligation to allow my child to participate in this study and that I may withdraw my child from the project at any time without being required to provide any explanation.

- I understand that tape-recorded or written records will only be used for research purposes, and that my child will **not** be identified by name on these at any time.

- I agree to my child...(name of child) participating in the above research project.

Name of Parent / Guardian...

Signed...Date..........................

Appendix 17

Individual participant variables for children with SLI and both control groups in Study 2

Test Age			**Gender**		
SLI	**CAC**	**VAC**	**SLI**	**CAC**	**VAC**
87	87	68	F	F	F
97	98	56	M	M	M
69	69	51	F	F	F
86	86	50	M	M	M
71	69	54	M	M	M
108	108	54	M	M	M
99	98	54	M	M	M
98	97	46	M	M	M
79	78	63	M	M	M
85	85	51	F	F	F
82	83	48	M	M	M
103	101	61	M	M	M
70	71	45	M	M	M
74	72	45	M	M	M
70	72	49	M	M	M
65	64	49	M	M	M

Block Design Standard Score			**BPVS Standard Score**			**BPVS Equivalent Age (months)**		
SLI	**CAC**	**VAC**	**SLI**	**CAC**	**VAC**	**SLI**	**CAC**	**VAC**
7	8	7	70	100	86	53	84	53
11	12	11	63	117	97	53	122	53
8	8	7	80	106	98	48	75	48
8	7	8	65	88	98	48	69	48
9	7	9	83	106	101	53	75	53
11	10	12	50	115	96	48	131	48
10	10	11	76	96	116	69	93	69
10	10	11	51	114	99	43	114	43
9	9	9	79	110	91	53	86	53
11	10	10	78	98	109	58	80	58
11	11	12	81	124	112	58	114	58
7	7	7	59	94	94	53	93	53
11	9	10	69	91	94	38	58	38
8	8	8	76	119	105	48	93	48
11	10	10	75	89	96	43	58	43
13	13	13	83	111	102	48	75	48

Appendix 18

Information sheet for parents of children with SLI (Study 3)

Vocabulary Learning in Children with Language Difficulties and Children with Normal Language Development

I am an experienced Speech and Language Therapist at the Royal Hospital for Sick Children and studying for a Ph.D. at the University of Edinburgh.

Approximately 18 months ago, you agreed to your child participating in a research study of word learning in children with language difficulties. In the information sheet which I provided at that time, I referred to a follow-up study in which I might see your child again to carry out some assessment of skills thought important for effective word learning. I am therefore approaching you again to ask whether you would agree to him/her taking part in this follow-up.

If you agree, I will arrange to see your child again in school. In the first instance I will carry out a brief assessment of his/her current vocabulary development. For some of the children this may be all I require. However this may be followed by a short task learning some names for people and animals in pictures. Then most children would be seen on 2 further occasions. In these sessions of approximately 20-25 minutes, I would carry out another brief word learning task and check what names your child remembers. There would also be some short assessments of his/her ability to categorise and tell the difference between speech sounds and also of memory for words/nonsense words. The activities would be varied and hopefully enjoyable.

If **appropriate to your child** and if there is sufficient time, at a later date, I may offer to provide a short course of therapy aimed at helping any difficulties with learning new words.

At all times the information I have about your child will be confidential and he/she will not be identified by name in any of the information I collect.

I hope that after reading this information and talking to your own speech and language therapist (if your child is still seeing one), that you feel able give your consent. **Participation is entirely voluntary however and should you wish to change your mind for any reason, you may withdraw at any time. This will not affect any speech/language therapy provision your child is currently receiving**. If you would like to speak to me before making up your mind, please get in touch.

Marysia Nash.
Address and phone number supplied

Appendix 18

Parental Consent Form; Children with SLI

Vocabulary Learning in Children with Language Difficulties and Children with Normal Language Development

- I have read this consent form and the subject information sheet and I have had the opportunity to ask questions about the study.
- I understand that I am under no obligation to allow my child to participate in this study and that I may withdraw my child from the project at any time without being required to provide any explanation. I understand that this will not affect any treatment my child
currently receives.
- I understand that tape-recorded or written records will only be used for research purposes, and that my child will **not** be identified by name on these at any time.
- I understand that this is non therapeutic research from which my child cannot expect to derive direct benefit.

I agree/do not agree* (**please delete as appropriate**) to my child... (name of child) participating in the above research project.

Name of Parent / Guardian..

Signed..Date..........................

cc Parent/ Guardian
Child's Speech and Language Therapist.(if appropriate)

Appendix 19
Information Sheet for Parents of Children in Control Groups (Study 3)

Vocabulary Learning in Children with Normal Language Development and Children with Language Difficulties.

I am an experienced Speech and Language Therapist working at the Royal Hospital for Sick Children and also studying for a Ph.D. at the University of Edinburgh.

Approximately 12-18 months ago, you agreed to your child participating in a research study of vocabulary learning. This was because I needed children **without** spoken language difficulties to compare with the children I had already seen with language difficulties.

In the information sheet which I provided at that time, I referred to a possible follow-up study in which I would like to see your child again to carry out some assessment of skills which might be important for effective word learning. I am therefore approaching you again to ask whether you would agree to him/her taking part in this follow-up.

If you agree, I will arrange to see your child again in school. In the first instance I will carry out a brief assessment of his/her current vocabulary development. For some of the children this may be all I require. However this may be followed by a short task learning some names for people and animals in pictures. Then most children would be seen on 2 further occasions. In these sessions of approximately 20-25 minutes, I would carry out another brief word learning task and check what names your child remembers. There would also be some short assessments of his/her ability to categorise and tell the difference between speech sounds and also of memory for words/nonsense words. The activities would be varied and hopefully enjoyable

At all times the information I have about your child will be confidential and he/she will not be identified by name in any of the information I collect.

I do hope that after reading this information, that you feel able to give your consent. **Participation is entirely voluntary however and should you change your mind for any reason, you may withdraw your child from the study at any time.** If you would like to speak to me before making up your mind, please get in touch.

Marysia Nash.
(address and phone number supplied)

Appendix 19
Parental Consent Form; Children in Control Groups

Vocabulary Learning in Children with Normal Language Development and Children with Language Difficulties

- I have read this consent form and the subject information sheet and I have had the opportunity to ask questions about the study.
- I understand that I am under no obligation to allow my child to participate in this study and that I may withdraw my child from the project at any time without being required to provide any explanation.
- I understand that tape-recorded or written records will only be used for research purposes, and that my child will **not** be identified by name on these at any time.

I agree/do not agree* **(please <u>delete</u> as appropriate)** to my child .... name of child) participating in the above research project.

Name of Parent / Guardian..

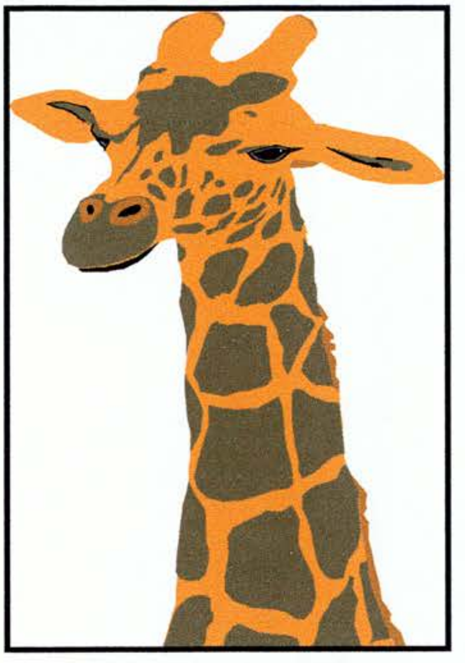
Signed...Date..........................

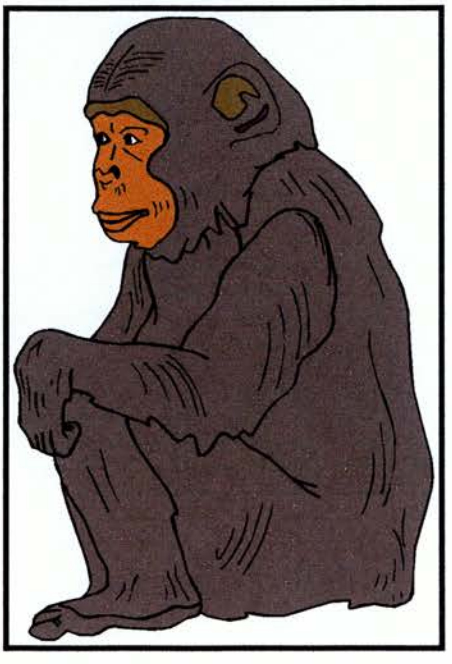
Appendix 20
Language Characteristics of the children with SLI included in Study 3

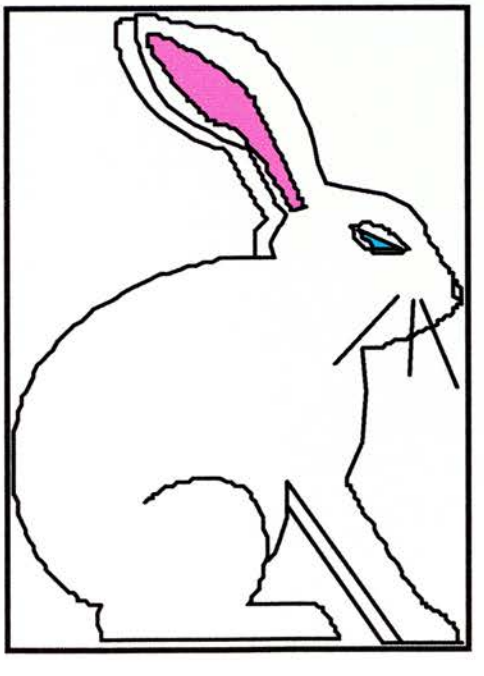
Shading indicates that the child had problems in that area of language or communication

Child	Receptive Vocabulary	Comprehension	Expressive language (grammar)	Expressive vocab	Phonology	Social communication
1.		No information	No information	No information	No information	
2.						
3.						
4.					No information	No information
5.						
6.						
7.		No information	No information	No information	No information	
8.		No information	No information	No information	No information	
9.		No information	No information	No information	No information	
10.		No information	No information	No information	No information	
11.					No information	No information
12.					No information	
13.		Different testing from Study 2			No information	No information
14.						
15.					No information	
16.						

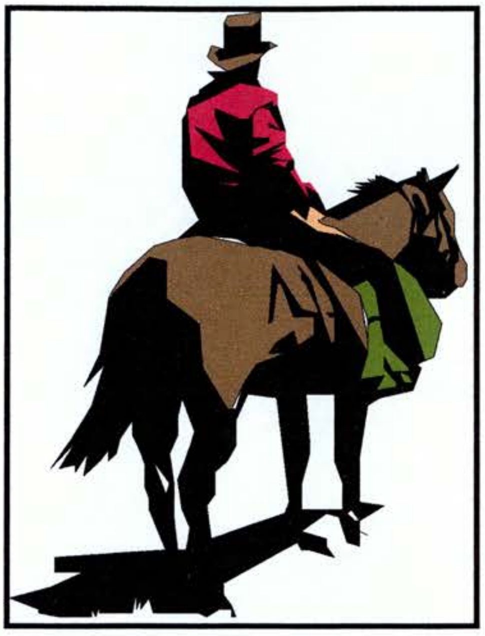
Pictures for Paired Associate Learning Tasks: Names & Non-names (Study 3)







People Pictures for Paired Associates Learning Tasks: Names & Non-names (Study 3)



Appendix 22
Paired Association Lexical Linking; Set A + Names (Final Version)

Child ____________________ Date____________________

I'm going to show you some pictures and tell you their names. Listen carefully because I'll ask you them later.

Trial 1 Listen
The postman is called Simon. What's the postman's name?
The cowboy is called Peter. What's the cowboy's name?
The driver is called Thomas. What's the driver's name?

Trial 2 OK Listen again
The driver is called Thomas What's the driver's name?
The postman is called Simon . What's the postman's name?
The cowboy is called Peter. What's the cowboy's name?

Trial 3 Listen again because I'm going to ask you soon.
The driver is called Thomas. What's the driver's name?
The cowboy is called Peter. What's the cowboy's name?
The postman called Simon . What's the postman's name?

Now what was the..
postman's name?____________
cowboy's name? ____________
driver's name ? ____________

Trial 4 Listen again
The postman is called Simon.
The cowboy is called Peter.
The driver is called Thomas.

Now what was the..
driver's name ? ____________
cowboy's name? ____________
postman's name?____________

Trial 5 Listen again
The cowboy is called Peter.
The postman is called Simon.
The driver is called Thomas

Now what was the..
cowboy's name?____________
driver's name ? ____________
postman's name?____________

Appendix 22 (cont)

Set A + Names (cont trials 6-10)
Child ____________________ Date____________________

Trial 6 Listen again
The postman is called Simon.
The cowboy is called Peter.
The driver is called Thomas.

Now what was the..
driver's name ? ____________
postman's name?____________
cowboy's name? ____________

Trial 7 Lets try again
The driver is called Thomas.
The cowboy is called Peter.
The postman is called Simon.

Now what was the..
cowboy's name?____________
driver's name ?____________
postman's name?____________

Trial 8 You're working hard. Listen again
The postman is called Simon.
The driver is called Thomas.
The cowboy is called Peter.

Now what was the..
postman's name?____________
driver's name ? ____________
cowboy's name?____________

Trial 9 Nearly finished
The driver is called Thomas.
The cowboy is called Peter.
The postman is called Simon.

Now what was the..
cowboy's name? ____________
postman's name? ____________
driver's name ? ____________

Trial 10 Last time
The postman is called Simon.
The cowboy is called Peter.
The driver is called Thomas.

Now what was the..
postman's name? ______________
cowboy's name?______________
driver's name ? ______________

Appendix 23

Paired Association Phonological Learning Set B+ Nonnames (Final Version)

Child ____________________ Date____________________

I'm going to show you some pictures and tell you their names. They're funny names but listen carefully because I'll ask you them later.

Trial 1
Listen
The rabbit is called Pimas (ae). What's the rabbit's name?
The giraffe is called Meton (ee). What's the giraffe's name ?
The monkey called Sommel What's the monkey's name?

Trial 2
OK Listen again.
The monkey is called Sommel. What's the monkey's name?
The rabbit is called Pimas (ae). What's the rabbit's name?
The giraffe is called Meton (ee). What's the giraffe's name ?

Trial 3 Listen again because I'm going to ask you soon.
The monkey is called Sommel. What was the monkey's name?
The giraffe is called Meton (ee). What was the giraffe's name?
The rabbit is called Pimas (ae). What was the rabbit's name ?

Now what was the..
rabbit's name? ___________
giraffe's name? ___________
monkey's name? _____________

Trial 4 Listen again.
The monkey is called Sommel .
The giraffe is called Meton (ee).
The rabbit is called Pimas (ae).

Now what was the ...
monkey's name?
rabbit's name?
giraffe's name?

Trial 5 Listen again.
The giraffe is called Meton (ee).
The monkey is called Sommel.
The rabbit is called Pimas (ae).

Now what was the..
monkey's name?_____________
giraffe's name?____________
rabbit's name?_____________

Appendix 23 (cont)

Set B+ Non Names (cont) Trials 6-10
Child's name ______________ date __________

Trial 6 Listen again.
The monkey is called Sommel
The giraffe is called Meton (ee)
The rabbit is called Pimas (ae).

Now what was the…
giraffe's name?______________
monkey's name? ________________
rabbit's name?_______________

Trial 7 Let's try again.
The rabbit is called Pimas.(ae)
The giraffe is called Meton (ee)
The monkey is called Sommel.

Now what was the..
rabbit's name?____________
monkey's name? ____________
giraffe's name? __________

Trial 8 You're working hard. Listen again
The giraffe is called Meton (ee)
The monkey is called Sommel.
The rabbit is called Pimas (ae)

Now what was the..
monkey's name?_______________
rabbit's name?_______________
giraffe's name?_______________

Trial 9 Nearly finished
The giraffe is called Meton (ee)
The monkey is called Sommel
The rabbit is called Pimas (ae).

Now what was the..
monkey's name?____________
giraffe's name?__________
rabbit's name?___________

Trial 10 Last time
The monkey is called Sommel).
The rabbit is called Pimas(ae).
The giraffe is called Meton (ee..

Now what was the..
rabbit's name? ____________
giraffe's name? ___________
monkey's name? ___________

Appendix 24

Auditory Discrimination Test (Phoneme Sequence)
(adapted from Bridgeman and Snowling (1988)

Child's Code ________________ DOB ___________ DOT _____________

I've got 2 pictures here. This is a space creature who came here in his spaceship from up in the sky. He met a boy called Shaun. This is Shaun. The space creature is teaching Shaun to talk like him. Lets see if Shaun can copy what the space creature/ alien says
The space creature (hold picture up) said .... Shaun (hold picture up) said......
Practise items: Noost noog gast gast tust tup hets hest
Did Shaun copy it/ say it the same?

Now lets do some more

Cover Mouth

1.	yayts yayst	yes	**no**
2.	doats doats	**yes**	no
3.	thits thist	yes	**no**
4.	futs futs	**yes**	no
5.	vots vost (aw)	yes	**no**
6.	kets kest	yes	**no**
7.	fost fots (aw)	yes	**no**
8.	hest hest	**yes**	no
9.	dist dits	yes	**no**
10.	vist vist	**yes**	no
11.	dats dast	yes	**no**
12.	fest fets	yes	**no**
13.	lowst lowts	yes	**no**
14.	yist yist	**yes**	no
15.	blayst blayts	yes	**no**

Appendix 25

Auditory Discrimination Test (Speech Segment) adapted from Adlard and Hazan (1998)

Child's Name Code ________________ DOB__________ DOT____________

I've got 2 pictures here. This is a space creature who came here in his spaceship from up in the sky. He met a boy called Shaun.. The space creature/ alien says he'll teach Shaun to talk like him. Lets see if Shaun can copy what the space creature says

The space creature (hold picture up) said .... Shaun (hold picture up) said......(only for practise items)

Cover Mouth

Practise items opo oglo ster spim eepee eepee snat snat

Set A	Item	Child's response	
1.	stib stib	**yes**	no
2.	aba apa	yes	**no**
3.	ada ada	**yes**	no
4.	aga ada	yes	**no**
5.	ada aba	yes	**no**
6.	smar snar	yes	**no**
7.	smaf smaf	**yes**	no
8.	stig spig	yes	**no**
9.	aga aka	yes	**no**
10.	aba aba	**yes**	no
11.	stiss spiss	yes	**no**
12.	ata ada	yes	**no**
13.	smaf snaf	yes	**no**
14.	snal smal	yes	**no**
15.	spib spib	**yes**	no

Lets have a little rest and then we can see how Shaun gets on with a few more.

Set B Cover Mouth

1.	ata ada	yes	**no**
2.	snass smass	yes	**no**
3.	apa apa	**yes**	no
4.	ata ata	**yes**	no
5.	spizz stizz	yes	**no**
6.	smag smag	**yes**	no
7.	spip stip	yes	**no**
8.	ada aba	yes	**no**
9.	sman snan	yes	**no**
10.	aga ada	yes	**no**
11.	stid spid	yes	**no**
12.	aba apa	yes	**no**
13.	stim stim	**yes**	no
14.	aga aga	**yes**	no
15.	aka apa	yes	**no**

Appendix 26

Auditory Discrimination (Pronunciation Judgement of Single Real Words) SET 1

Child ______________________________ **Date of Test**__________________

The space creature has been learning some words all by himself . Sometimes he says them right and sometimes he still makes mistakes. I'll show you a picture and tell you what he said. Say "yes" if he said the name of the picture right and "no" if he said it wrong.

Practise Items: apple aggle snake stake bubbles bubbles

Cover Mouth

1. snowman	**yes**	no
2. forest	**yes**	no
3. brekfats	yes	**no**
4. crocodile	**yes**	no
5. butterfly	**yes**	no
6. spick	yes	**no**
7. stider	yes	**no**
8. sping	yes	**no**
9. tider	yes	**no**
10. sneeze	**yes**	no
11. tetty	yes	**no**
12. toast	**yes**	no
13. heligopter	yes	**no**
14. vets	yes	**no**
15. toothpatse	yes	**no**

Auditory Discrimination (Pronunciation Judgement of Single Real Words) SET 2

Child ______________________________ **Date of Test**__________________

The space creature has been learning some words all by himself . Sometimes he says them right and sometimes he still makes mistakes. I'll show you a picture and tell you what he said. Say "yes" if he said the name of the picture right and "no" if he said it wrong.

Practise items: fast fats smile skile baby baby

Cover Mouth

1. spider	**yes**	no
2. smeeze	yes	**no**
3. toats	yes	**no**
4. helicopter	**yes**	no
5. bukkerfly	yes	**no**
6. crogodile	yes	**no**
7. sting	**yes**	no
8. toothpaste	**yes**	no
9. vest	**yes**	no
10. smowman	yes	**no**
11. stick	**yes**	no
12. teddy	**yes**	no
13. forets	yes	**no**
14. tiger	**yes**	no
15. breakfast	**yes**	no

Appendix 27

Test form: Rhyme Matching Test (Final Version for Study 3)

Rhyme Matching				
Practise Items				
Here we have	**box**	toys	door	leg
	Which one rhymes with fox? Fox rhymes with…..			
Here we have	shapes	cat	**night**	school
	Which one rhymes with dight ? Dight rhymes with….			
Here we have	watch	fish	bag	**coat**
	Which one rhymes with loat? Loat rhymes with….			
Here we have	**think**	fire	ball	pig
	Which one rhymes with sink? Sink rhymes with….			
Test Items				
Here we have	**pan**	wood	neck	cup
	Which one rhymes with man ? Man rhymes with….			
Here we have	peas	**van**	bike	food
	Which one rhymes with man? Man rhymes with….			
Here we have	chop	**can**	tree	peg
	Which one rhymes with man? Man rhymes with….			
Here we have	sun	boat	car	**bell**
	Which one rhymes with pell? Pell rhymes with….			
Here we have	cap	**smell**	bus	snow
	Which one rhymes with pell? Pell rhymes with….			
Here we have	**yell**	book	house	cup
	Which one rhymes with pell? Pell rhymes with….			
Here we have	cat	nose	**trees**	sheep
	Which one rhymes with bees ? Bees rhymes with….			
Here we have	rose	feet	doll	**cheese**
	Which one rhymes with bees? Bees rhymes with….			
Here we have	**keys**	mouth	seat	eyes
	Which one rhymes with bees ? Bees rhymes with….			
Here we have	ball	shoes	**mop**	rope
	Which one rhymes with dop? Dop rhymes with….			
Here we have	ship	fog	mouth	**hop**
	Which one rhymes with dop? Dop rhymes with….			
Here we have	shirt	**top**	rip	hot
	Which one rhymes with dop? Dop rhymes with….			
Here we have	**bear**	face	hat	car
	Which one rhymes with pear? Pear rhymes with……			
Here we have	star	cake	**fair**	sheep
	Which one rhymes with pear? Pear rhymes with……			
Here we have	**hair**	bed	cage	door
	Which one rhymes with pear? Pear rhymes with……			

Appendix 28

Rhyme Production Test

Child_______________ Date of Birth____________ DOT____________

Introduce the concept of rhyme (words that sound the same at the end) using a nursery rhyme and provide some examples of rhyme.
Jill hill. Top hop pop

Now that you know what rhyme is , I'm going to say some real words or some funny words to you and you have to tell me some words that rhyme with it. They can be real words or made up words. See if you can think of 3 for each one

Practise items
Walk: Walk rhymes with.......Walk rhymes with....... Walk rhymes with.....
Mun: Mun rhymes with........ Mun rhymes with........ Mun rhymes with.....
Shoe: Shoe rhymes with.... ....Shoe rhymes with........ Shoe rhymes with...
Fy: Fy rhymes with........... Fy rhymes with..... ... Fy rhymes with...
Now we've had a little practise see if you can think of 3 rhymes for these ones

	Word	**Child responses** Can help as above if necessary
1.	tall	
2.	yest	
3.	hold	
4.	sen	
5.	hent	
6.	drink	
7.	nog	
8.	rop	
9.	bin	
10.	sat	

Appendix 29

Digit Span Test

Name of Child ______________________________ Date of Test ____________________

"I am going to say some numbers . Listen carefully and when I have finished you say them right after me."

Read the digits at the rate of one per second dropping voice inflection slightly on the last digit in a series
(from Wisc 111) UK 1991

Discontinuation criteria

If more than one error on any of the lists of a particular length stop testing at that length.
If only one list was wrong try the 4th list . If correct proceed. If not stop. (basically the child has to get either 3/3 or 3/4 to proceed).

3 6 9 2 8 7 (8 4)	______ ______ ______ ______
8 1 7 1 5 6 3 2 8 (6 1 4)	____________ ____________ ____________ ____________
6 4 1 5 3 9 7 4 2 7 6 3 (5 9 2 8)	_______________ _______________ _______________ _______________
8 1 5 2 6 6 4 1 3 2 7 6 3 1 9 (8 2 1 6 4)	________________ ________________ ________________ ________________
1 2 9 8 4 6 4 8 7 2 9 1 8 4 2 7 9 3 (8 7 1 3 5 2)	____________________ ____________________ ____________________ ____________________
1 7 2 8 3 4 9 3 9 2 4 6 1 5 6 1 4 2 8 3 9 (1 5 7 2 3 4 9)	____________________ ____________________ ____________________ ____________________

Length of span ____________

Appendix 30

Percentages of children getting 'something right' on each word; Naming

	Naming Time 1			Naming Time 2		
Words	SLI	VAC	CAC	SLI	VAC	CAC
Aster	6.25(1)	6.25(1)	18.75(3)	12.50(2)	56.25 (9)	68.75 (11)
Polka	12.50(2)	6.25(1)	50.0(8)	43.75(7)	56.25 (9)	87.5 (14)
Molasses	6.25(1)	12.50(2)	31.25(5)	31.25(5)	68.75(11)	81.25 (13)
Phial	0.00(0)	12.50(2)	37.50(6)	12.50(2)	18.75 (3)	68.75 (11)
Mica	0.00(0)	0.00(0)	0.00 (0)	12.50(2)	25.00 (4)	56.25 (9)
Gauntlet	0.00(0)	6.25(1)	18.75(3)	31.25(5)	43.75 (7)	68.75 (11)
Albatross	6.25(1)	25.00(4)	56.25 (9)	43.75(7)	75.00(12)	75.00(12)
Kale	0.00(0)	0.00(0)	18.75(3)	6.25(1)	31.25 (5)	68.75 (11)

Percentages of children getting 'something right' on each word; Word Recognition

	Word recognition Time 1			Word recognition Time 2		
Words	SLI	VAC	CAC	SLI	VAC	CAC
Aster	37.5 (6)	56.25(11)	87.50(14)	68.75(11)	75.00 (12)	100.00(16)
Polka	56.25 (9)	75.00(12)	93.75(15)	87.50(14)	93.75 (15)	100.00(16)
Molasses	56.25 (9)	62.50(10)	81.25(13)	93.75(15)	75.00(12)	100.00(16)
Phial	62.50(10)	62.50(10)	93.75(15)	81.25(13)	75.00 (12)	100.00(16)
Mica	62.50(10)	62.50(10)	100.00(16)	81.25(13)	75.00 (12)	100.00(16)
Gauntlet	75.00(12)	81.25(13)	100.00(16)	93.75(15)	81.25 (13)	100.00(16)
Albatross	62.50(10)	68.75(11)	75.00 (12)	81.25(13)	87.50(14)	100.00(16)
Kale	50.00 (8)	81.25(13)	100.00(16)	68.75(11)	87.50 (14)	100.00(16)

Appendix 30 (cont)
Percentages of children getting 'something right' on each word; Word Description

Words	Word description Time 1 SLI	VAC	CAC	Word description Time 2 SLI	VAC	CAC
Aster	18.75 (3)	25.00 (4)	43.75 (7)	43.75 (7)	50.00(8)	68.75(11)
Polka	37.50 (6)	18.75 (3)	62.50(10)	31.25 (5)	68.75(11)	93.75(15)
Molasses	18.75 (3)	18.75 (3)	50.00 (8)	43.75 (7)	12.50(2)	68.75(11)
Phial	6.25 (1)	0. 00 (0)	18.75 (3)	12.50 (2)	6.25(1)	37.50 (6)
Mica	18.75 (3)	37.50 (6)	62.50(10)	56.25 (9)	56.25 (9)	68.75(11)
Gauntlet	12.50 (2)	25.00 (4)	68.75(11)	56.25 (9)	75.00(12)	93.75(15)
Albatross	43.75 (7)	43.75 (7)	75.00(12)	68.75(11)	75.00(12)	87.50(14)
Kale	12.50 (2)	12.50 (2)	62.50(10)	62.50(10)	25.00 (4)	75.00(12)

Percentages of children getting 'something right' on each word; Meaning Recognition

Words	Meaning recognition Time 1 SLI	VAC	CAC	Meaning recognition Time 2 SLI	VAC	CAC
Aster	43.75 (7)	43.75 (7)	81.25(13)	50.00 (8)	87.50(14)	93.75 (15)
Polka	25.00 (4)	56.25 (9)	93.75(15)	81.25(13)	50.00 (8)	93.75 (15)
Molasses	37.50 (6)	43.75 (7)	68.75(11)	56.25 (9)	75.00(11)	81.25 (13)
Phial	43.75 (7)	25.00(4)	68.75(11)	50.00 (8)	50.00 (8)	75.00 (11)
Mica	62.50(10)	81.25(13)	87.50 (0)	81.25(13)	87.50(14)	100.00(16)
Gauntlet	68.75(11)	68.75(11)	93.75(15)	75.00(12)	87.50 (14)	100.00(16)
Albatross	81.25(13)	56.25 (9)	100.00(16)	75.00(12)	75.00(12)	100.00(16)
Kale	68.75(11)	50.00 (8)	87.50(14)	68.75(11)	87.50 (14)	100.00(16)

Appendix 30 (cont)
Percentages of children getting 'something right' on each word; Picture Comprehension

Words	Picture comprehension Time 1			Picture comprehension Time 2		
	SLI	VAC	CAC	SLI	VAC	CAC
Aster	75.00(12)	56.25 (9)	93.75(15)	62.50(10)	75.00 (12)	100.00(16)
Polka	68.75(11)	87.50(14)	93.75(15)	93.75(15)	87.50 (14)	100.00(16)
Molasses	56.25 (9)	81.25(13)	87.50(14)	68.75(11)	93.75(15)	100.00(16)
Phial	75.00(12)	100.00(16)	87.50(14)	81.25(13)	93.75 (15)	93.75(15)
Mica	62.50(10)	68.75(11)	93.75(15)	87.50(14)	75.00 (12)	100.00(16)
Gauntlet	75.00(12)	100.00(16)	93.75(15)	87.50(14)	100.00(16)	100.00(16)
Albatross	75.00(12)	75.00(12)	100.00(16)	81.25(13)	81.25(13)	100.00(16)
Kale	50.00 (8)	68.75(11)	87.50(14)	62.50(10)	68.75(11)	81.25(13)

References

Adlard, A., & Hazan, V. (1998). Speech perception in children with specific reading difficulties (dyslexia), Quarterly Journal of Experimental Psychology Section-A Human, 51(1), 153-177.

Aitcheson, J. (1972). Mini-malapropisms, British Journal of Disorders of Communication, 7, 38-43.

Aitcheson, J., & Chiat, S. (1981). Natural Phonology or Natural Memory? The Interaction between Phonological Processes and Recall Mechanisms, Language and Speech, 24 (4), 311-326.

Aitcheson, J. (1994). Words in the Mind. Oxford: Basil Blackwell Ltd.

Ajuriaguerra, d. J., Jaeggi, A., Guignard, F., Kocher, F., Maquard, M., Roth, S., & Schmid, E. (1976). The Development and Prognosis of Dysphasia in Children, in D. M. a. M. Morehead, A.E (Ed.), Normal and Deficient Child Language. Baltimore: University Park Press.

Avons, S. E., Wragg, C., A, Cupples, L., & Lovegrove, W. J. (1999). Measures of phonological short-term memory and their relationship to vocabulary development, Applied Psycholinguistics, 19(4), 583-601.

Baddeley, A. D., & Hitch, G. J. (1974). Working Memory. In G. Bower (Ed.), The psychology of learning and motivation (Vol. 8, pp. 47-90). New York: Academic Press.

Baddeley, A. D., Papagno, C., & Vallar, G. (1988). When long term learning depends on short-term storage, Journal of Memory and Language, 27, 586-595.

Baddeley, A. (1993). Short-term phonological memory and long term learning - a single case study, European Journal of Cognitive Psychology, 5 (2), 129 -148.

Baddeley, A., Gathercole, S., & Papagno, C. (1998). The Phonological Loop as a Language Learning Device, Psychological Review, 105 (1), 158-173.

Beck, I. L., Perfetti, C. A., & Mc Keown , M. G. (1982). Effects of Long-term vocabulary instruction on lexical access and reading comprehension, Journal of Educational Psychology, 74, 506-521.

Bernstein, L. E., & Stark, R. E. (1985). Speech Perception Development in Language Impaired Children: A 4-Year Follow-up Study. Journal of Speech and Hearing Disorders, 50, 21-30.

Bird, J., & Bishop, D. (1992). Perception and awareness of phonemes in phonologically impaired children, European Journal of Disorders of Communication, 27(4), 289-311.

Bird, J., Bishop, D. V. M., & Freeman, N. H. (1995). Phonological Awareness and Literacy development in Children with Expressive Phonological Impairments, Journal of Speech and Hearing Research, 38, 446-462.

Bishop, D. V. M. (1983). Test of Reception of Grammar: Chapel Press.

Bishop, D. V. M. (1990). A Prospective Study of the Relationship between Specific Language Impairment, Phonological Disorders and Reading Retardation, Journal of Child Psychology and Psychiatry, 31(7), 1027-1050.

Bishop, D. V. M., Byers Brown, B., & Robson, J. (1990). The relationship between phoneme discrimination, speech production and language comprehension in cerebral-palsied individuals, Journal of Speech and Hearing Research, 33, 210-219.

Bishop, D. V. M. (1992). The Underlying Nature of Specific Language Impairment, Child Psychology and Psychiatry, 33, 3-66.

Bishop, D. V. M., North, T., & Donlan, C. (1996). Nonword repetition as a behavioural marker for inherited language impairment: evidence from a twin study, Journal of Child Psychology and Psychiatry, 37, 391-403.

Bishop, D. V. M. (1997a). Cognitive Nueropsychology and Developmental Disorders: Uncomfortable Bedfellows, The Quarterly Journal of Experimental Psychology, 50A(4), 899-923.

Bishop, D. V. M. (1997b). Uncommon Understanding. Development and Disorders of Language Comprehension in Children. Hove: Psychology Press.

Bishop, D. V. M., Bishop, S. J., Bright, P., James, C., Delaney, T., & Tallal, P. (1999). Different Origin of Auditory and Phonological Processing Problems in Children with Language Impairment: Evidence from a Twin Study, Journal of Speech, Language and Hearing Research, 42, 155-168.

Bloom, P., & Kelman, D. (1995). Syntactic cues in the acquisition of collective nouns. Cognition, 56, 1-30.

Bloom, P., & Lori, M. (1998). Capacities underlying word learning. Trends in Cognitive Sciences, 2(2), 67-73.

Bridgeman, E., & Snowling, M. (1988). The perception of phoneme sequence: A comparison of normal and dyspraxic children, British Journal of Disorders of Communication, 23 (3), 245-252.

Bryan, A. & North, C. (1994). Developmental cognitive neuropsychology: a comparison of 2 case studies, Child Language Teaching and Therapy, 10 (3), 313-328.

Bryan, A. (1995). 'Boxes and arrows for children'. Royal College of Speech and Language Therapists Bulletin, November1995 (523).

Carey, S. (1978). The child as a word learner. In M. Halle, J. Bresnan, & G. Miller (Eds.), Linguistic theory and psychological reality, Cambridge M.A: MIT Press.

Carey, S., & Bartlett, E. (1978). Acquiring a single word, Papers and Reports on Child Language Development, 15, 17-29.

Casby, M. W. (1992). An Intervention Approach for Naming Problems in Children. American Journal of Speech and Language Pathology, 1, 35-42.

Chiat, S. and Hunt, J. (1993). Connections between phonology and semantics: an exploration of lexical processing in a language impaired child, Child Language Teaching and Therapy, 9 (3), 200-213.

Clark, E. V. (1995). The lexicon in acquisition. Cambridge: Cambridge University Press.

Constable, A., Stackhouse, J., & Wells, B. (1997). Developmental Word-finding Difficulties and Phonological Processing: The Case of the Missing Handcuffs, Applied Psycholinguistics, 18, 507-536.

Coolican, H. (1995). Research Methods and Statistics in Psychology. (Second ed.). London: Hodder and Stoughton.

Conti-Ramsden, G., Donlan, C., & Grove, J. (1992). Characteristics of children with specific language impairment attending language units. European Journal of Disorders of Communication, 27(4), 325-342.

Conti-Ramsden, G., Crutchley, A. C., & Botting, N. F. (1998). The Extent to which Psychometric Tests Differentiate Subgroups of Children with SLI, Journal of Speech, Language and Hearing Research, 40, 765-777.

Crystal, D. (1987). Teaching Vocabulary: The case for a semantic curriculum. Child Language Teaching and Therapy., 3 (1).

Daneman, M., & Green, I. (1986). Individual differences in comprehending and producing words in context. Journal of Memory and Language, 25, 1-18.

Dell, G. S., & O' Seaghdha, P. G. (1992). Stages of lexical access in language production. Cognition, 42, 287-314.

Dockrell, J., Messer, D., George, R., & Wilson, G. (1997,). Naming in Children with Word-Finding Difficulties - delay or differences in object naming? Paper presented at the Child Language Seminar, Institute of Linguistics University of Amsterdam.

Dockrell, J. E., Messer, D., George, R., & Wilson, G. (1998). Children with word - finding difficulties - prevalence, presentation and naming problems, International Journal of Language and Communication Disorders, 33 (4), 445-454.

Dockrell, J., & Messer, D. (1999). Children's Language and Communication Difficulties. London and New York: Cassell Education.

Dollaghan, C. (1985). Child meets word: "Fast Mapping" in Preschool children, Journal of Speech and Hearing Research, 28, 449-454.

Dollaghan, C. A. (1987). Fast Mapping in Normal and Language Impaired Children, Journal of Speech and Hearing Disorders, 52, 218-222.

Dunn, L. M., Whetton, C., Burley, J., & Dunn, L. M. (1982). British Picture Vocabulary Scale 2nd Edition . Edinson Windsor: NFER- Nelson.

Easton, C., Sheach, S., & Easton, S. (1997). Teaching vocabulary to children with word-finding difficulties using a combined semantic and phonological approach: an efficacy study, Child Language Teaching and Therapy, 13 (2), 125-142.

Echols, C. H., & Newport, E. L. (1992). The Role of Stress and Position in Determining First Words. Language Acquisition, 2(3), 189-220.

Echols, C. (1993). A perceptually-based model of children's earliest productions, Cognition, 46, 245-296.

Edwards, J., & Lahey, M. (1998). Nonword repetitions of children with specific language impairment, Applied Psycholinguistics, 19, 279-309.

Elley, W. B. (1989). Vocabulary acquisition from listening to stories. Reading Research Quarterly, 24, 174-187.

Elliot, L., Hammer, M. & Scholl, M. (1989). Fine grained auditory discrimination in normal children and children with language learning problems, Journal of Speech and Hearing Disorders, 32, 112-119.

Ellis, A. W. & Young, A. W. (1988). Human Cognitive Neuropsychology. London: Lawrence Erlbaum Associates.

Ellis Weismer, S. & Hesketh, L. J. (1993). The influence of prosodic and gestural cues on novel word acquisition by children with specific language impairment, Journal of Speech and Hearing Research, 336, 1013-1025.

Ellis Weismer, S. & Hesketh, L. J. (1996). Lexical Learning by Children with Specific Language Impairment: Effects of Linguistic Input Presented at Varying Speaking Rates, Journal of Speech and Hearing Research, 39, 177-190.

Ellis Weismer, S., Tomblin, J. B., Zhang, X., Buckwalter, P., J.G, C. & Jones, M. (2000). Nonword Repetition Performance in School-Age Children With and Without Language Impairment, Journal of Speech, Language and Hearing Research, 43, 865-878.

Faust, M., Dimitrovsky, L., & Davidi, S. (1997). Naming Difficulties in Language Disabled Children: Preliminary findings with the application of the tip-of-the-tongue paradigm. Journal of Speech, Language and Hearing Research, 40, 1026-1036.

Frumhoff, P., Echols, C. H., & Newport, E. L. (1992). Perceptual Salience and operating principals for language acquisition: The effect stress and end of word. University of Texas, Austin TX: Unpublished manuscript.

Gathercole, S. E. & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study, Journal of Memory and Language, 28, 200-213.

Gathercole, S. E. & Baddeley, A. D. (1990). The role of phonological memory in vocabulary acquisition: A study of young children learning new names, British Journal of Psychology, 81, 439-454.

Gathercole, S. E. & Baddely, A. D. (1990). Phonological Memory Deficits in Language Disordered Children: Is There a Causal Connection? Journal of Memory and Language, 29, 336-360.

Gathercole, S., Willis, C., Emslie, H. & Baddeley, A. D. (1991a). The influences of number of syllables and wordlikeness on children's repetition of nonwords, Applied Linguistics, 12, 349-367.

Gathercole, S. E., Willis, C. & Baddeley, A. D. (1991b). Differentiating phonological memory and awareness of rhyme: reading and vocabulary development in children, British Journal of Psychology, 82, 387-406.

Gathercole, S. E., Willis, C. S., Emslie, H. & Baddely, A. D. (1992). Phonological Memory and Vocabulary Development During the Early School Years: A Longitudinal Study, Developmental Psychology, 28(5), 887-898.

Gathercole, S. E. & Baddely, A. (1993). Working Memory and Language, Lawrence Erlbaum Associates.

Gathercole, S. E. (1993). Word Learning in Language Impaired Children, Child Language Teaching and Therapy, 9 (3), 187-199.

Gathercole, S. E., Willis, C., Baddeley, A. D., & Emslie, H. (1994). The Children's Test of Nonword Repetition: A test of phonological working memory, Memory, 2, 103-127.

Gathercole, S. E., Hitch, G. J., Service, E. & Martin, A. J. (1997). Phonological Short-Term memory and New Word Learning in Children, Developmental Psychology, 33(6), 966-979.

Gathercole, S. E. (1999). Cognitive approaches to the development of short-term memory, Trends in Cognitive Sciences, 3(11), 410-419.

Gathercole, S. E., Service, E., Hitch, G. J., Adams, A.-M. & Martin, A. J. (1999). Phonological Short-term memory and Vocabulary Development: Further Evidence on the Nature of the Relationship, Applied Cognitive Psychology, 13, 65-77.

Gertner, B. L., Rice, M. L., & Hadley, P. A. (1994). Influence of communicative competence on peer preferences in a preschool classroom. Journal of Speech and Hearing Research, 37, 913-923.

Gilbertson, M. & Kamhi, A. G. (1995). Novel Word Learning in Children with Hearing Impairment, Journal of Speech and Hearing Research, 38, 630-642.

Gilhooly, K. J. & Logie, R. H. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words, Behaviour Research Methods and Instrumentation., 12 (4), 395-427.

Gleitmann, L. R. (1994). Words words words, Philosophical Transactions of the Royal Society, B, 346, 71-77.

Hadley, P. A., & Rice, M. L. (1991). Conversational responsiveness of speech and language impaired pre-schoolers. Journal of Speech and Hearing Research, 34, 1308-1317.

Hall, W.S., Nagy, W. E. & Linn, R. (1984). Spoken words: Effects of situation and social group on oral word usage and frequency. Hillsdale, NJ: Lawrence Erlbaum

Hatcher, P. J., Hulme, C., & Ellis, A. W. (1994). Ameliorating reading failure by integrating the teaching of reading and phonological skills: The phonological linkage hypothesis. Child Development, 65, 41-57.

Haynes, C. (1982). Vocabulary Acquisition Problems in Language Disordered Children, unpublished MSc, University of London.

Haynes, C. (1992). Vocabulary deficit - one problem or many? Child Language Teaching and Therapy, 8 (1), 1-17.

Heibeck, T. H., & Markman, E. M. (1987). Word Learning in Children: An Examination of Fast mapping, Child Development., 58, 1021-1034.

Howard, D., & Patterson, K. (1992). The Pyramids and Palm Trees Test . Bury St. Edmunds: Thames Valley Test Company.

Howell, D. C. (1987). Statistical Methods for Psychology. Boston: PWS-Kent Publishing Company.

Hyde Wright, S., Gorrie, B., Haynes, C. & Shipman, A. (1993). What's in a name? Comparative therapy for word-finding difficulties using semantic and phonological approaches, Child Language Teaching and Therapy, 9 (3), 214-229.

Hyde-Wright, S. (1993). Teaching word-finding strategies to severely language impaired children, European Journal of Disorders of Communication, 28 (2), 165-175.

James, D., Vansteenbrugge, W., & Chiveralls, K. (1994). Underlying deficits in language-disordered children with central auditory processing difficulties, Applied Psycholinguistics, 15(3), 311 -328.

Kail, R., & Leonard, L. (1986). Word Finding Abilities in Language Impaired Children (Asha Monograph 25).

Katz, R. B. (1986). Phonological deficiencies in children with reading disability: evidence from an object naming task, Cognition, 22, 225-257.

Kiernan, B. & Gray, S. (1998). Word Learning in a Supported-Learning Context by Preschool Children with Specific Language Impairment, Journal of Speech, Language and Hearing Research, 41, 161-171.

Law, J., Boyle, J., Harris, F., Harkness, A., & Nye, C. (2000). Prevalence and natural history of primary speech and language delay: findings from a systematic review of the literature. International Journal of Communication Disorders, 35 (2), 165-188.

Leonard, L. B., Schwartz, R. G., K, C., Rowan, L. E., Prelock., P. A., Terrell, B., Weiss, A. L. & Messick, C. (1982). Early Lexical Acquisition in Children with Specific Language Impairment, Journal of Speech and Hearing Research, 25, 554-564.

Leonard, L. B., Schwartz, R. G., Swanson, L. A., & Frome Loeb, D. M. (1987). Some conditions that promote unusual phonological behaviour in children, Clinical Linguistics and Phonetics, 1 (1), 23-34.

Leonard, L. B. (1988). Lexical Development and Processing in Specific Language Impairment. In R. L. Shiefelbusch & L. L. LLoyd (Eds.), Language perspective: acquisition, retardation and intervention, (2nd ed.). Austin, Texas: Pro-Ed.

Leonard, L. B., Schwarz, R. G., Allen, G. D., Swanson, L. A., & D, F. L. (1989). Unusual phonological behaviour and the avoidance homonymy in children, Journal of Speech and Hearing Research, 32, 583-590.

Leonard, L. B. (1998). Children with Specific Language Impairment. Cambridge, MA: MIT Press

Levelt, W. J. M. (1989). Speaking From Intention to Articulation. Cambridge, Massachusetts; London, England: MIT Press.

Levelt, W., J.M. (1999). Models of Word Production. Trends in Cognitive Sciences, 3(6), 223-232.

Lewis, S., & Speake, J. (1998). When is a rolling pin a 'roll the pen': a clinical insight into lexical problems, in S. Chiat & J. Law (Eds.), Language Disorders in Children and Adults. London: Whurr.

Locke, J. L. (1980a). The inference of speech perception in the phonologically disordered child. Part 1: A rationale, some criteria, the conventional tests. Journal of Speech and Hearing Research, 45, 431 -444.

Locke, J. L. (1980b). The inference of speech perception in the phonologically disordered child. Part 11: Some clinically novel procedures, their use, some findings, Journal of Speech and Hearing Disorders, 45, 445-468.

Markman, E. M., & Hutchinson, J. E. (1984). Children's sensitivity to constraints in word meaning: taxonomic versus thematic relations. Cognitive Psychology, 16; 1-27.

Marsh, C. (1988). Exploring Data. Cambridge: Polity.

Marslen-Wilson, W. (1989). Access and Integration : Projecting Sound onto Meaning. In Marslen-Wilson, W. (Ed.), Lexical Representation and Process. Cambridge Massachusetts: MIT Press.

Masterton, J., Hazan, J., & Wijayatilake, L. (1995). Phonemic Processing Problems in Developmental Phonological Dyslexia, Cognitive Nueropsychology, 12 (3), 223-259.

Mc Cauley, R. J., & Swisher, L. (1984a). Psychometric Review of Language and Articulation Tests for Preschool Children. Journal of Speech and Hearing Disorders, 49, 34-42.

Mc Cauley, R. J., & Swisher, L. (1984b). Use and Misuse of Norm-referenced Tests in Clinical Assessment: A Hypothetical Case. Journal of Speech and Hearing Disorders, 49, 338-348.

McGregor, K. K., & Leonard, L. B. (1989). Facilitating word-finding skills of language-impaired children, Journal of Speech and Hearing Disorders, 54, 141-147.

McGregor, K. K. (1994). Use of phonological information in a word-finding treatment for children, Journal of Speech and Hearing Research, 37, 1381-1393.

Mc Gregor, K. K., & Windsor, J. (1996). Effects of Priming on the Naming Accuracy of Preschoolers with Word-Finding Deficits. Journal of Speech and Hearing Research, 39, 1048-1058.

McGregor, K. K. (1997). The Nature of Word-Finding Errors of Preschoolers With and Without Words-Finding Deficits. Journal of Speech, Language and Hearing Research, 40, 1232-1244.

Mc Gregor, K. K., & Waxman, S. R. (1998). Object naming at multiple hierarchical levels: a comparison of preschoolers with and without word-finding deficits. Journal of Child Language, 25, 419-430.

Metsala, J. L. (1999). Young Children's Phonological Awareness and Nonword Repetition as a Function of Vocabulary Development, Journal of Educational Psychology, 99(1), 3-19.

Meyer, A. S. (1990). The Time Course of Phonological Encoding in Language Production : The Encoding of Successive Syllables of a Word. Journal of Memory and Language, 29, 524-545.

Michas, I. C., & Henry, L. A. (1994). The link between phonological memory and vocabulary acquisition, British Journal of Developmental Psychology, 12, 147-163.

Miller, J. (1991). Research on Language Disorders in Children: A Progress Report, in J. Miller (Ed.), Research on Language Disorders in Children. A decade of progress . Austin Texas: Pro-Ed.

Mogford-Bevan, K. P., & Summersall, J. (1998). Emerging literacy in children with delayed speech and language development: assessment and intervention. Child Language Teaching and Therapy, 13(2), 143-159.

Montgomery, J. W. (1995). Examination of phonological working memory in specifically language impaired children, Applied Psycholinguistics, 16, 355-378.

Murphy, L. A., Pollatsek, A., & Well, A. D. (1988). Developmental Dyslexia and Word Retrieval deficits, Brain and Language, 35, 1-23.

Nagy, W., & Herman, P. A. (1987). Breadth and Depth of Vocabulary Knowledge: Implications for Acquisition and Instruction, in M. G. McKeown & M. E. Curtis (Eds.), The Nature of Vocabulary Acquisition. Hillsdale New Jersey; London: Lawrence Erlbaum Associates.

Oetting, J. B., Rice, M. L., & Swank, l. K. (1995). Quick Incidental Learning (QUIL) of Words by School-Age Children With and Without SLI, Journal of Speech amd Hearing Research, 38, 434-445.

O' Hara, M., & Johnston, J. (1997). Syntactic bootstrapping in children with specific language impairment. European Journal of Disorders of Communication, 32, 147-163.

Pany, d., Jenkins, J. R., & Schreck, J. (1982). Vocabulary Instruction; Effects on Word Knowledge and Reading Comprehension, Learning Disability Quarterly, 5, 202-215.

Papagno, C., & Vallar, G. (1992). Phonological short-term Memory and the Learning of Novel words: The effect of Phonological Similarity and Item Length, The Quarterly Journal of Experimental Psychology, 44 A (1), 47-67.

Plante, E., Swisher, L., Kiernan, B. & Restrepo, M. (1993). Language Matches: Illuminating or Confounding, Journal of Speech and Hearing Research, 36, 772-776.

Plante, E., & Vance, R. (1994). Selection of Preschool Language Tests : A Data Based Approach. Language, Speech and Hearing Services in Schools, 1994 (25), 15-24.

Ralli, A. (1999) Exploring patterns of lexical acquisition: context and cognition. Unpublished Doctoral Dissertation. University of London

Reynell, J. K. (1985). The Reynell Developmental Language Scales (2nd Edition) . Windsor, Berks: NFER-Nelson.

Rice, M. L., & Woodsmall, L. (1988). Lessons from television: Children's word learning when viewing, Child Development, 59 (2), 420 -429.

Rice, M. L., Buhr, J. C., & Nemeth, M. (1990). Fast mapping word learning abilities of language delayed pre-schoolers, Journal of Speech and Hearing Disorders, 55.

Rice, M. L., Buhr, J., & Oetting, J. B. (1992). Specific-Language-Impaired Children's Quick Incidental Learning of Words: The Effect of a Pause, Journal of Speech and Hearing Research, 35, 1040-1048.

Rice, M. L., Oetting, J. B., Marquis, J., Bode, J., & Pae, S. (1994). Frequency of input effects on word comprehension of children with specific language impairment, Journal of Speech and Hearing Research, 37 (1).

Rice, M. L., Cleave, P. L., & Oetting, J. B. (2000). The Use of Syntactic Cues in Lexical Acquisition by Children with SLI. Journal of Speech Language and Hearing Research, 43, 582-594.

Robbins, C., & Ehri, L. (1994). Reading Storybooks to Kindergartners Helps Them Learn New Vocabulary Words, Journal of Educational Psychology, 86(1), 56-64.

Robson, C. (1993). Real world research. A resource for social scientists and practitioner researchers. Oxford: Blackwell.

Roelofs, A. (1997). The WEAVER model of word-form encoding in speech production. Cognition, 64, 249-284.

Schwartz, R. G., Leonard, L. B., Messick, C., & Chapman, K. (1987). The acquisition of object names in children with specific language impairment: Action context and word extension, Applied Psycholinguistics, 8, 233-244.

Schwartz, R. G. (1988). Early action word acquisition in normal and language impaired children, Applied Psycholinguistics, 9, 111-122.

Semel, E., Wiig, E., & Secord, W. (1987). Clinical Evaluation of Language Fundamental-Revised. New York: Psychological Corporation.

Snowling, M., Goulandris, N., Bowlby, M. & Howell, P. (1986). Segmentation and Speech Perception in Relation to Reading Skill: A Developmental Analysis, Journal of Experimental Child Psychology, 41, 489-507.

Snowling, M., van Wagtendonk, B., & Stafford, C. (1988). Object-naming Deficits in Developmental Dyslexia, Journal of Research in Reading, 11 (2), 67-85.

Snowling, M., Chiat, S., & Hulme, C. (1991). Words, nonwords and phonological processes: Some comments on Gathercole, Willis, Emslie, and Baddely, Applied Psycholinguistics, 12, 369-373.

Stackhouse, J. (2000). Barriers to literacy development in children with speech and language disorders, in D. V. M. Bishop & L. Leonard (Eds.), Speech and Language Impairments in Children: Causes, characteristics, intervention and outcome, Hove, East Sussex: Psychology Press.

Stark, R. E., & Tallal, P. (1981). Selection of Children with Specific Language Deficits, Journal of Speech and Hearing Disorders, 46, 114-122.

Sternberg, R. J. (1987). Most vocabulary is learned from context . In M. G. M. Keown & M. E. Curtis (Eds.), The nature of vocabulary acquisition. Hillsdale, NJ: Erlbaum.

Stothard, S., & Snowling, M. Graded Naming Test: Unpublished

Stothard, S. E., Snowling, m. J., Bishop, D. V. M., Chipchase, B. B. & Kaplan, C. A. (1998). Language Impaired Pre-schoolers: A Follow-up into adolescence, Journal of Speech, Language and Hearing research, 41,4107-4118

Swan, D. & Goswami, U. (1997). Picture Naming Deficits in Developmental Dyslexia: The Phonological Representations Hypothesis. Brain and Language, 56, 334- 353.

Taylor, M., & Gelman, S. A. (1988). Adjectives and Nouns: Children's strategies for learning new words. Child Development., 59, 411 - 419.

Trauner, D., Wulfeck, B., Tallal, P., & Hesselink, J. (2000). Neurological and MRI profiles of children with developmental language impairment. Developmental Medicine and Child Neurology, 42, 470-475.

Vihmann, M. M. (1981). Phonology and the development of the lexicon, Journal of Child Language, 8, 239-264

Wechsler, D. (1990). Wechsler Pre-school and Primary Scale of Intelligence- Revised UK Edition . Sidcup, Kent: The Psychological Corporation.

Wechsler, D. (1992). Wechsler Intelligence Scale for Children-third Edition UK . Sidcup, Kent: The Psychological Corporation.

Wagner, R., & Torgensen, J. (1987). The nature of phonological processing and it's causal role in the acquisition of reading skills. Psychological Bulletin.

Walley, A. C. (1993). The Role of Vocabulary Development in Children's Spoken Word Recognition and Segmentation Ability, Developmental Review, 13, 286-350.

Wells, G. (1986). The meaning makers: Children learning language and using language to learn. Postsmouth , NH: Heinemann.

Wiig, E. H., Semel , E., & Nystrom, I. (1982). Comparison of rapid naming abilities in language learning disabled and academically achieving eight-year-olds, Language Speech and Hearing Services in Schools, 13, 11-23.

Wiig, E. H., Secord, W., & Semel, E. (1992). The Clinical Evaluation of Language Fundamentals- Pre-school . San Antonio, San Diego, Orlando, Chicago New York: Psychological Corporation, Harcourt Brace Jovanovich.

Wing, C. S. (1990). A preliminary investigation of generalisation to untrained words following 2 treatments of children's word-finding problems. Language, Speech and Hearing Services in Schools, 21, 151-156.

Wolf, M., & Obergon, M. (1992). Early Naming Deficits, Developmental Dyslexia, and a Specific Deficit Hypothesis, Brain and Language, 42, 219 - 247.